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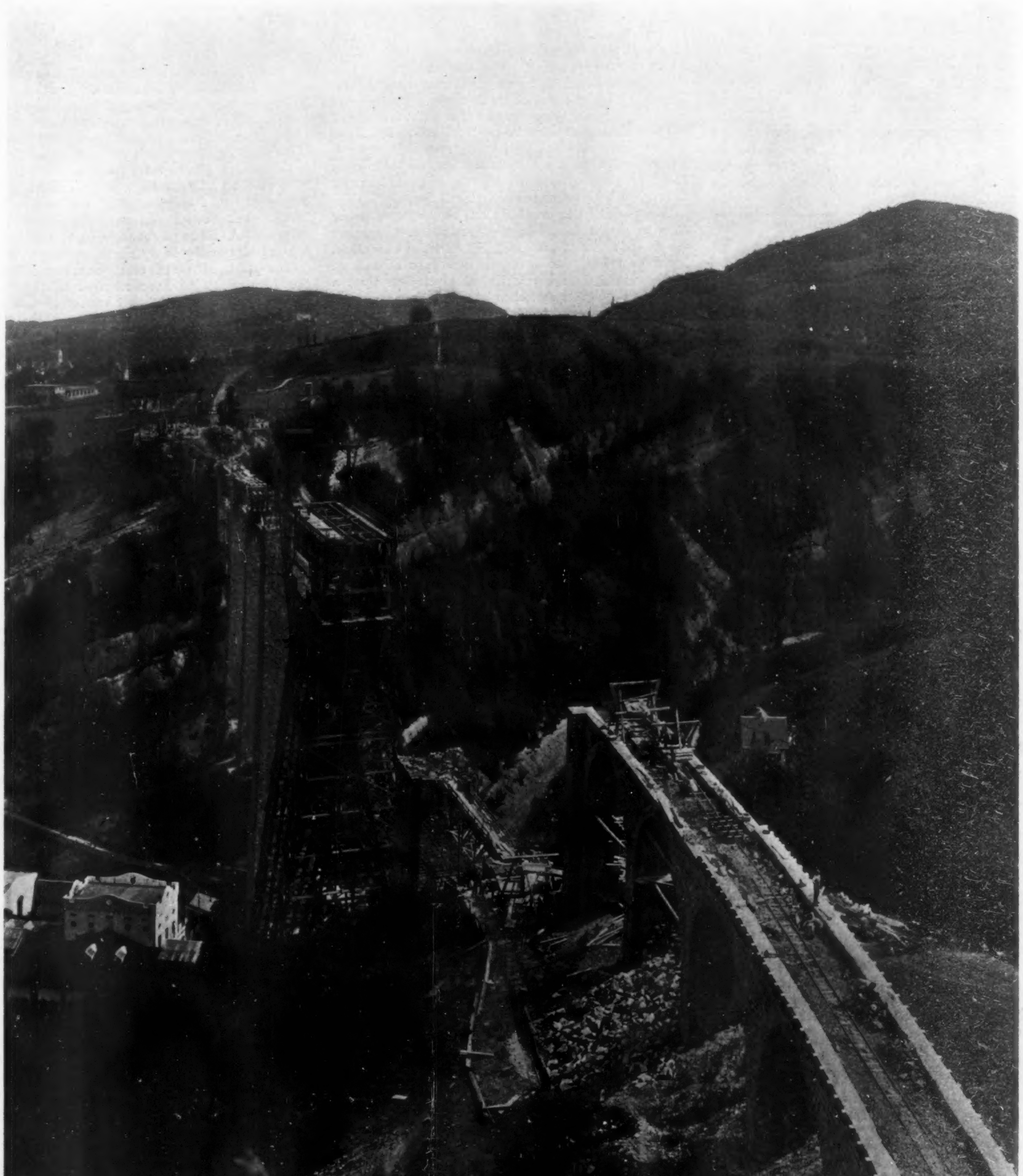

THE GREATEST VIADUCT OF EUROPE - SITTER, SWITZERLAND. - [See page 298.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Ramming of the "Olympic"

SOME years ago, in the merry scramble to get home quickly from one of the America cup races off Sandy Hook, the steamer "Monmouth" found herself overlapping the yacht "Corsair" as these two speedy craft were nearing a turning buoy in the old Gedney Channel. The writer, who was aboard the "Monmouth," noting that the two vessels, in the wish to make a close turn at the buoy, were drawing very closely together, was watching the action of the bow wave and wash and wake of the one vessel upon the other. When the "Monmouth" had drawn half her length ahead of the "Corsair," the latter sheered slightly toward the "Monmouth," apparently with the intention of swinging in closely under her stern, preparatory to turning. After the "Corsair's" bow had approached slowly to within a certain distance of the "Monmouth," the yacht suddenly closed in and struck the "Monmouth." The blow was delivered as swiftly as though the helm had been put hard over for the purpose.

It was evident to the writer that the lateral force which swung the "Corsair's" bow so quickly against the "Monmouth" was due to the lateral inflow of the water, displaced at the bow of the "Monmouth," as it closed upon her stern. Naval Constructor D. W. Taylor recently investigated this matter in the course of some interesting experiments in the model tank at Washington, in which he determined the action of vessels upon one another when they are steaming in close proximity and upon parallel courses. This investigation proved that under such circumstances any two ships have a strong tendency to close in upon one another. Judging from the cabled reports, the ramming of the "Olympic" was due to conditions similar to those above referred to. The cruiser "Hawke," a relatively insignificant vessel of 7,000 tons displacement, was steaming abreast of and in rather close proximity to the "Olympic," when the cruiser's navigating officer decided apparently to pass under the stern of the big ship. He probably put his helm over to what would have been the correct amount to enable him to execute this maneuver safely in undisturbed water; but as soon as his bow swung over into the wash of the steamer the "Hawke" appears to have been drawn against the "Olympic," exactly as was the "Corsair" against the "Monmouth."

The disaster serves to show that there is safety in size. The ship which did the ramming weighs about 7,000 tons; the "Olympic" at the time of the disaster weighed probably about 60,000 tons. Judging from the speed of the "Hawke," she struck a blow which probably would have sent a ship of average size to the bottom; but so huge is the "Olympic" that the enormous rent which was torn in her skin-plating and the flooding which followed seem to have had but little effect upon her stability. She was never at any time in serious danger. The extra strength and stiffness of her bulkheads rendered them amply sufficient to withstand the strain of flooded compartments. It is probable that if the accident had happened at sea and in rough weather the big ship would have made her way comfortably back to port.

The Radium Engine

IN his remarkable British Association address, Sir William Ramsay stated that the disintegration of radium liberated three and one-half million times the energy available by the explosion of an equal volume of detonating gas—a mixture of one volume of oxygen with two volumes of hydrogen. He pointed out that the major part of this energy comes apparently from the expulsion of particles (that is, of atoms of helium) with enormous velocity. "Suppose," says Sir William, "suppose that the energy in a ton of radium could be utilized in thirty years instead of being evolved at its invariable slow rate of one thousand seven hundred and sixty years for one-half disintegration, it would suffice to propel a ship of 15,000 tons, with engines of 15,000 horse-power, at the rate of 15 knots an hour, for thirty years, practically the lifetime of the ship. To do this actually requires one and one-half million tons of coal."

Here is a statement of radium's possibilities that may well give a steam engineer pause. Why bother about thermo-dynamics, about Carnot cycles, about the relative merits of turbines and reciprocating engines? Why not develop the radium engine and conserve our coal supplies, and manipulate ounces of radium instead of tons of coal? At one fell blow all our elaborate coal-conveying machinery disappears, and with it roaring furnaces, the blackened faces of stokers, and all the sooty paraphernalia that the word "steam engine" stands for.

The possibilities are far more romantic on paper than in actual fact. In the first place, where are we to get a ton of radium? Sir William himself in times past has placed the total supply of radium in the world, in laboratories, at much less than a pound. Physicists and chemists have time and time again pointed out the enormous personal risk involved in handling even a half grain of comparatively pure radium. Bacteria, insects and even mice, we believe, have actually been killed by radium rays, suitably applied, to be sure. What will be the effect upon a man sitting in a room containing, let us say, ten pounds of radium? Would he ever emerge alive? Obviously, the mere difficulty of handling so terrible a substance imposes problems far more difficult of solution than those which the old steam engine ever offered.

Assuming that we really had a safe method of handling a large quantity of radium, how are we to make its energy available in practical form? Some totally new type of prime mover must be developed, some contrivance which will render it possible for electrons hurled into space with the speed of light to do their work.

Then again there is the subject of materials to be considered. Radio-active substances are no respecters of ordinary containers. The particles projected from radium permeate most substances with comparative ease. To confine them would be a far more serious task than the insulation of a steam pipe.

Stupendous as the problem is, who shall be bold enough to say that it will never be solved? After all, is the utilization of the enormous energy contained in a half grain of radium any more startling than the transformation of the energy pent up in a shovelful of black coal? If the radium engine ever does come, it will simply be another instance of the triumph of mind over matter.

From the Complex to the Simple

A MARKED step was taken in the simplification of prime movers when Watt's cumbersome beam engine, with its ingenious but elaborate parallel motion, gave way to the present standard reciprocating type, with only piston rod, cross head and connecting rod interposed between piston and crank. An even greater advance toward ideal simplicity occurred when, after years of effort by inventors to produce a practical rotary, Parsons brought out his compact, though costly, turbine, in which the energy of the steam is developed on a zigzag path through multitudinous rows of fixed and moving blades.

And now comes Mr. Tesla with a motor which bids fair to carry the steam engine another long step toward the ideally simple prime mover—a motor in which the fixed and revolving blades of the turbine give place to a set of steel disks of simple and cheap construction. If the flow of steam in spiral curves between the adjoining faces of flat disks is an efficient method of developing the energy of the steam, the prime mover would certainly appear to have been at last reduced to its simplest terms.

The further development of the unique turbine which we describe elsewhere will be followed with close attention by the technical world. The results attained with this small high-pressure unit are certainly flattering, and give reason to believe that the addition of a low pressure turbine and a condenser would make this type of turbine as highly efficient as it is simple and cheap in construction and maintenance.

Lessons of the Transcontinental Flight

ON September 12th and 13th two biplanes, a Wright, piloted by Robert G. Fowler, and a Curtiss, driven by James Ward, left San Francisco and New York, respectively, in an attempt to fly across the continent in less than thirty days. Under the rules the flight must be finished by October 10th. In view of the automobile record of fifteen days, the flyers thought they had ample time, even allowing for accidents. Special trains with several extra machines were reported to be in close pursuit, and if any accidents were met with, it was expected that repairs would be promptly made.

Aviator Fowler made an excellent start on September 12th, circling over the Golden Gate and San Francisco Bay and making his first stop at Sacramento. After replenishing, he continued on to Colfax in the foot-hills of the Sierras. He was just beginning the long climb of more than 5,000 feet to the summit (7,018 feet) when, at Alta, the control wire of the vertical rudder broke and he came fluttering down in spirals. The machine was badly broken, but Fowler fortunately was not seriously injured. A delay of ten days occurred before the biplane was ready to fly again.

The start of Ward from Governor's Island on the 13th seems to have resulted in the bad luck generally attributed to that number. Little Ward is the youngest and lightest aviator of the transcontinental race trio. After losing his way at the start, he was delayed by motor troubles of various kinds, chiefly by lack of lubrication, due to faulty operation of the oil pump or leakage of oil from the crank case. Even after testing his new motor thoroughly on *terra firma,* he was unable to fly many miles before he was forced to alight for further repairs. In alighting he hit a tree and smashed his machine again, which caused him to abandon the race.

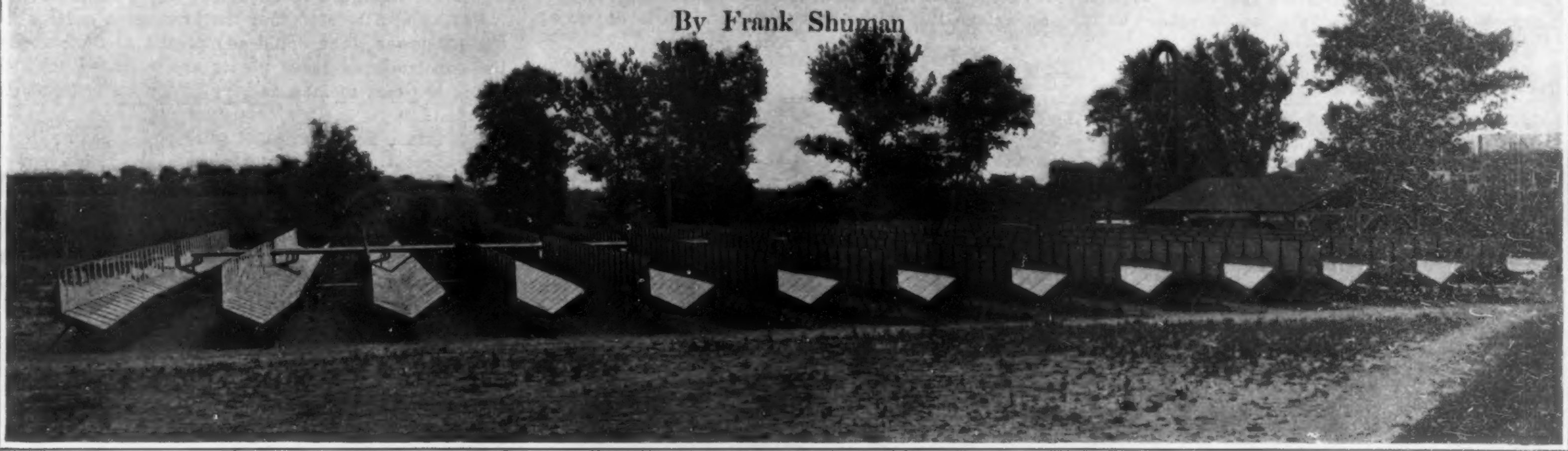
An excellent start was made by Calbraith P. Rogers on Sunday, September 17th. Rogers, who like his brother, Lieut. Rogers of the Navy, flies a Wright biplane, departed from Sheepshead Bay at 4:33 P. M. on Sunday. He flew directly across Brooklyn and New York, crossed the Hudson opposite Madison Square, and picked out the Erie tracks by means of white streamers that had been placed on the ground along the line of the railroad. He flew without a stop to Middletown, N. Y., where he arrived 1¾ hours after his start from Sheepshead Bay. The total distance covered was 84 miles, which corresponds to an average speed of 48 miles an hour. In starting from the race track at Middletown the next morning, Rogers came to grief and smashed his machine. The place from which to start was very restricted and the machine was unable to lift the heavy six-foot-four aviator quickly enough to avoid a large willow tree directly in his path. Rogers skillfully turned aside and cleared the tree, only to hit the top of another tree, which upset his machine and tumbled it to the ground. Rogers landed upon his feet after a fall of 30 feet or more and was uninjured, but his aeroplane was badly smashed. In four days, however, he had secured new parts and reconstructed his machine, and on September 21st, at 2:29 P. M., he left Middletown. With a strong, favorable wind to aid him, he covered 80 miles or more in 1 hour and 6 minutes, and alighted at Hancock at 3:35 P. M. The next day he covered 250 miles in all, but got off his course at Susquehanna and made a detour to Scranton, Pa., before reaching Binghamton. He was over 6 hours in flight and finally reached Elmira.

The results of the race to date have demonstrated that training in cross-country flying is essential in order to make a good performance in a race of this kind. Rogers' accident was due to faulty judgment, but besides this he wandered from the course owing to his inexperience in cross-country work. The accident which happened to Fowler is one which should not happen to any well-made aeroplane. This is not the only time that a control wire has broken on a Wright machine while in flight. The delay caused by the breakage of his rudder wire may cost Fowler the race. He is indeed lucky that he escaped without serious injury, as the vertical rudder is considered by the Wrights to be quite essential to their system of control. Using the warping alone Fowler managed to descend in spirals, but he was unable to pick a suitable landing place.

Power from Sunshine

A Pioneer Solar Power Plant

By Frank Shuman



THE direct utilization of the natural forces in the development of power suitable for human activities has been for centuries a matter of continued scientific research.

To a limited extent these forces have been used from the dawn of civilization in the common forms of the windmill and various types of water-driven motors. It has not, however, been hitherto possible to practically utilize the central dominating forces of nature—the sun's heat—in any direct manner, though obviously all power generators are dependent upon this great source for their existence.

For many years engineers and physicists have been occupied with this problem; notably Ferry, Millochan, Mouchat and Tellier in France; Güntner and Althaus in Germany; and Langley, John Ericsson, and Willsie in America. These experimenters based their efforts either upon the use of lenses or mirrors to concentrate the sun's rays upon a small surface, or upon the heating of fluids of a low-boiling point, with subsequent power generation from the vapor under pressure. It has always been attempted to create vapor at high pressure, and then utilize this in the ordinary engine, but with the high temperatures involved, the losses by conduction and convection are so great that the power produced was of no commercial value. Where lenses or mirrors are used, the primary cost of the lenses, and the apparatus necessary to continuously present them toward the sun, have rendered them impracticable.

Where fluids of low boiling point, such as ether, sulphurous acid, and liquid ammonia were used, the results were of little value by reason of the inherent inadequateness of these fluids as power generators.

A sun-power plant, in order to be practicable, must possess, first, high efficiency; low cost of installation and maintenance; well-marked length of service; and should not require specially trained mechanics for its operation.

In order to be efficient, it is not necessary that the plant generate continuously, inasmuch as the great value of such a plant lies in its use as an irrigation apparatus; it is only necessary that the plant run about eight hours daily. It must, however, consist of units which may be assembled to produce a power plant of any required size, the larger the plant the greater the efficiency. It is entirely practicable to produce a sun-power plant in this manner up to 10,000 horse-power and over. An ideal plant must be subject to little accident; hence, it must lie near the ground in order not to be affected by storms and winds. Each unit must be repairable without stopping the operation; construction must be simple and easily understood by the ordinary steam engineer; and wear and tear must be reduced to a minimum.

The first cost of a sun-power plant to be practical, and of commercial value, must be sufficiently low so that the interest on the investment does not make it unprofitable. This is the rock on which, thus far, all sun-power propositions were wrecked. It is not necessary that the cost of the sun heat absorber shall be as low as that of a steam boiler and fitting of the same power. The cost of the plant described herein is twice that of the ordinary steam-power plant of the same size. This price is sufficiently low, however, so that even if the extra interest is taken into consideration, the fact that after installation no fuel is required, is such an enormous advantage as to entirely offset the increased cost, and in addition cause great profits.

Some ten years ago the writer became interested in the problem of obtaining power by absorbing the sun's rays. It was found, by experiment, that if a vessel were so arranged that the sun's rays could impinge upon it, and if all heat losses by conduction, convection and radiation were prevented by a theoretically perfect method of insulation, the temperature within the vessel would rise certainly to a thousand degrees Fahrenheit without any attempt being made to concentrate the rays of the sun. For commercial purposes it is impossible to secure any form of insulation which would even approach the theoretical. Commercially, the main object is to produce practical power at a minimum cost, and this has been done by the use of well-known and cheap forms of heat insulation.

Were no steam made in these vessels, as they are arranged in the present plant, the temperature therein would go up to 350 deg. F. in latitude 40 north, possibly easily to 450 deg. F. near the equator. The production of steam at atmospheric pressure, however, keeps the temperature in the vessels down to 212 degrees; and whatever excess of heat is produced by the sun's rays over and above that lost, is converted into steam, and may therefore be utilized.

The experience of additional years will, no doubt, lead to designs considerably better than this first attempt on a commercial scale. Sun power must go through the same long and gradual course of development that has brought other forms of mechanical power to the present high plane of efficiency, but the principle will remain fundamentally correct.

With this idea in mind the first Shuman generator was built. It consisted of a wooden box covered by two layers of glass, between which was a small air space, and in the box was placed a miniature ether boiler. This apparatus was exposed to the sun's rays, the ether distilled, and the amount of heat which might be absorbed was determined. As an experiment, a small toy engine was successfully run with this original apparatus. A second generator consisted of a 2-inch steam pipe 16 feet long, insulated at the bottom, and inclosed in a box covered by a double layer of glass. Here again ether was distilled, and the number of heat units absorbed were determined. A third type of power plant was composed of a bed of water pipes properly insulated against heat loss, the unit being 18 x 60 feet, and the motor being an ether engine. With this apparatus 3½ horse-power was obtained. With the knowledge so gained, the present generator, to be described below, was gradually evolved.

The sun-power plant in its present development consists of the absorber, a low-pressure steam engine, condenser, and auxiliaries.

The absorber, in a general way, is composed of a series of units, each containing a flat metal honeycomb water vessel rectangular in shape, and resembling closely a large waffle. This vessel is inclosed in a flat wooden box covered with two layers of glass having a 1-inch air space between them, and having the under surface of the box insulated against heat loss downward by a 2-inch layer of regranulated cork and two layers of water-proof cardboard.

The boxes are mounted on supports which elevate them some 30 inches above the ground, and which permit them to be inclined perpendicular to the sun at the meridian. These adjustments of the inclination need only be made about once in three weeks.

Plane mirrors of cheap construction are mounted on two sides of the boxes in order that more rays of the sun may be absorbed and reflected upon the surface of the water vessel. This latter is connected at one end to a feed pipe from the water supply, and at the other end to a steam pipe. The steam pipes from the various units are connected together and empty into a main 8 inches in diameter in the present plant, which conveys the steam to the engine.

The engine is a new type, low pressure, reciprocating steam engine of great steam economy. Connected with it is a condenser of ordinary type and auxiliaries such as may be found in any condensing plant. The water from the condenser is pumped back into the absorber, thus insuring a continuous closed circuit whose only water loss is from accidental leakage, which is carefully guarded against.

The power of this first plant is used for pumping water by means of a reciprocating steam pump of the ordinary type, and whenever the sun has shone during the past six weeks, this plant has pumped water successfully and practically. The capacity of the present plant, in this latitude, is 3,000 gallons of water per minute, lifted to a height of 33 feet.

From actual tests made in Philadelphia in August, 1911, it was found that from the absorber of 26 banks of units, each containing 22 single units and having a light absorptive area of 10,296 square feet and an actual area of 5,148 square feet, there could be developed during eight hours 4,825 pounds of steam. The power produced was much lower than normal to the plant, as it was built for tropical use and was entirely unfitted for commercial work in northern latitudes.

It is found by observation that the steam generated in a sun-power plant is reduced largely by humidity and the presence in the air of smoke, haze, etc. It follows, then, that the efficiency will be greatly increased when the apparatus is tested in a dry climate free from atmospheric impurities attendant upon proximity to a large city. The plant was set up at Philadelphia, not because it was considéred to be a commercial thing there, but because the necessary experimenting with a new plant thousands of miles from home would have been exceedingly expensive. Within a month or two this plant will be taken down and erected in Egypt. This can be conveniently done, as the entire heat absorber is practically portable.

Again, the loss of heat by conduction and convection in northern latitudes is enormous. If the present apparatus is placed in an average air temperature of 100 deg. F., such as obtains throughout all equatorial regions, it is safe to assume that the power will be multiplied three-fold.

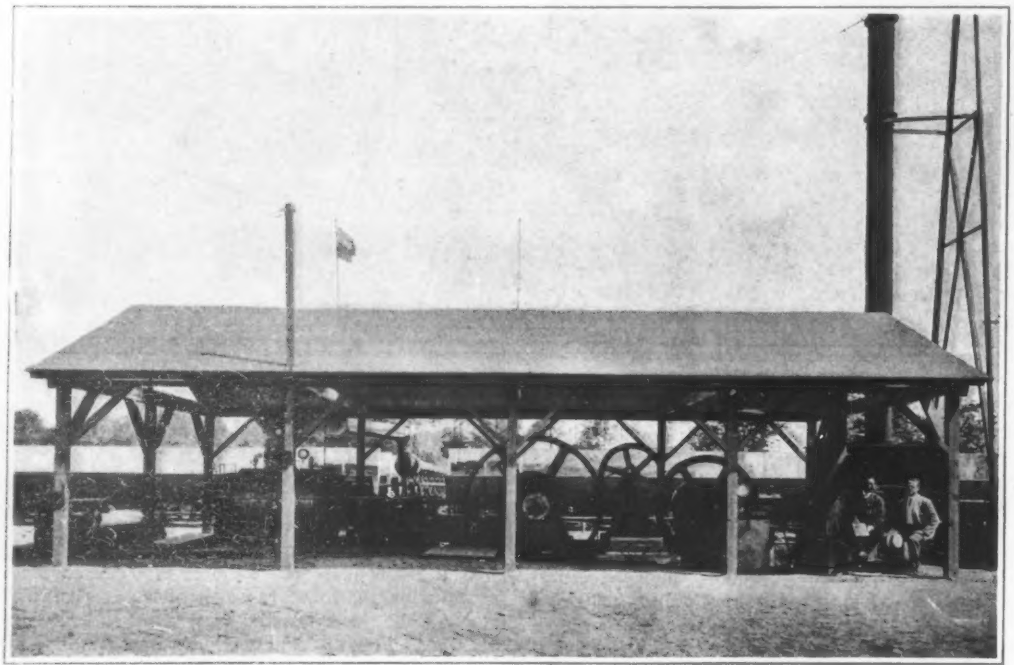
Having described the mechanism of the sun-power plant, it remains to discuss the opportunities for its use. The immediate opportunities for sun power are in those regions in the tropics where the sun practically shines throughout the year, and fuel is very expensive, coal costing in some localities $30 per ton.

There is room now for at least half a million horse-power in such tropical fields as the nitrate district of Chile, the borax industry in Death Valley, and for general purposes in places where the outside temperature runs from 110 to 140 degs. F.

As an irrigation engine there is no limit to the amount of power that can be practically utilized; and for this purpose the conditions need not be so very favorable as those mentioned above. Throughout most of the tropical regions *sun power will prove very profitable in irrigation.* One advantage of the sun power, or, in fact, of any condensing plant for irrigating purposes, is that the water used for the condenser costs nothing, as the main output of the engine can be passed through the condenser first be-

fore entering the irrigating canals for distribution.

The interior of Australia was, at one time, a fertile country, as is evidenced by the fossilized trees. Here is an area of some 600 miles in each direction which is entirely valueless. During a drought there have been times when one-third of the sheep raised on the margins of this desert died from thirst, causing great financial loss. In this locality the sun shines with an intensity sufficient to produce an average daily temperature of 100 to 140 degs. F. The occasional rains nourish the sparse vegetation necessary for sheep, which are watered from wells driven in the ground and pumped, generally by horse power, very often by hand, and sometimes by means of fuel oil, which, by the time it reaches its destination, brings the coal equivalent up to some $20 per ton. By building sun engines in this region, and pumping from the always present underground water which in this region lies at a depth of from 15 to 40 feet, this country can be made productive and valuable.



Front view of engine, auxiliaries and water pump.

Throughout Eastern India and Ceylon many thousands of square miles of farm land can be improved three-fold by mechanical irrigation. Hand pumping is mainly the present form of irrigation used.

In Egypt agriculture depends entirely upon irrigation furnished by the River Nile through its periodic overflow. The English government built the Assuan Dam at an enormous expense, and widened the irrigable area about half a mile on each side of the Nile, thus adding greatly to the tillable portion of Egypt. Of course, when the Nile is in flood infinitely more water than necessary is furnished; but the demand is for a supply which can be depended on from day to day, especially at seasons of low water. This supply at present is furnished by the hand labor of some 100,000 fellaheen who pump by means of the shadoof method. One sun engine, such as is now erected in Tacony, will do the work of about a thousand of these laborers.

Throughout Arizona, Nevada, New Mexico and Southern California there is room for any amount of power for irrigating purposes alone. These States show an average of 90 per cent sun light, and the cost of fuel is practically prohibitive in most of this region.

To summarize all of the above statements, it may be assumed that 10 per cent of the earth's land surface will eventually depend upon sun power for all mechanical operations. Given inexhaustible power, which is, of course, always obtainable from the sun, and utilizing the nitrogen in the air for fertilizer in the form of nitrates and such compounds as calcium cyanamide, the human race will be enabled to draw directly on the source of all life for power and sustenance.

A question of paramount importance in the possibilities of a general use of sun power is the cost of the apparatus.

In the Shuman type of sun-power plant, the engine, condenser and auxiliaries are similar to those in daily use by steam plants, and may therefore be eliminated from comparison; leaving the absorber and the ordinary steam boiler alone to be compared. It is found that at this time the initial cost of the sun-heat absorber in question is about double that of a first-class boiler plant of equal power.

The great economy occurs in the item of fuel. In districts especially suitable for sun power the cost of coal, or its equivalent, is usually very high, the price ranging generally from $10 to $30 per ton. To offset this, no fuel at all is required by the sun heater.

In the matter of maintenance and repairs also the advantage lies with the sun power. It is estimated that the repairs should not be in excess of 5 per cent per year on the initial cost, inasmuch as the apparatus works at low temperature, while the ordinary boiler requires flue gases up to 2,500 degrees. This wear of the parts must manifestly be much greater in the latter form of power plant.

Many parts of the sun-power plant, such as the metal heaters, piping, foundation and insulation, are practically everlasting, barring accidental breakage, the only item of repair being the wooden frames and glass covers; and it is found that after an installation of glass has once been tested out by the heat, and the badly annealed sheets replaced, the remainder will last for years. This was evidenced by the small 18 x 60 feet heater in operation for three years in Philadelphia. There was a replacement of about 10 per cent necessary during the first three weeks; thereafter the heater ran three seasons and only two or three sheets of glass needed replacement, these being accidentally broken.

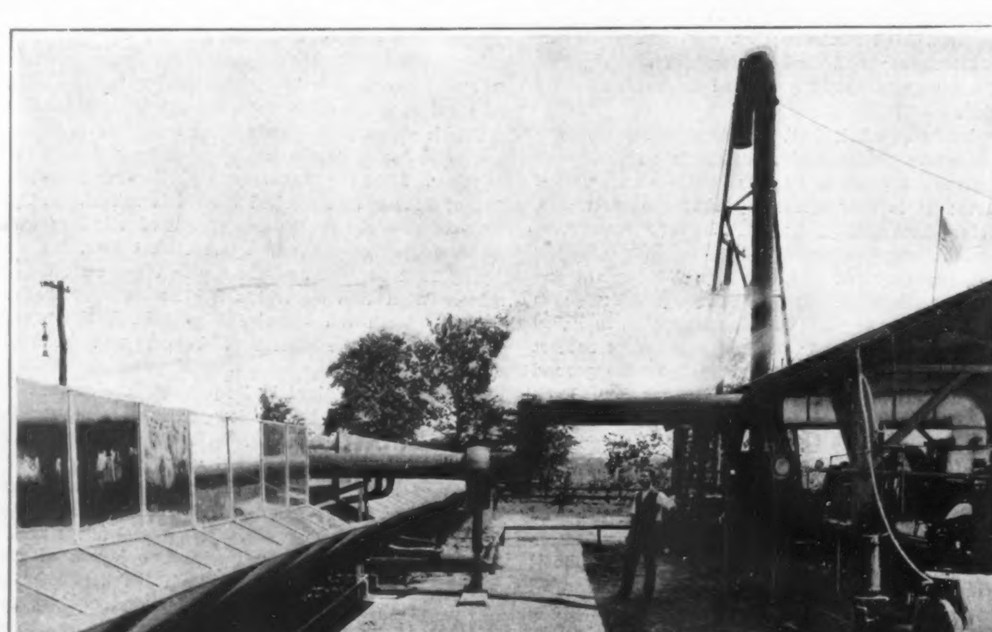
There is now being tested out a celluloid-like material having all the necessary properties of glass and being flexible and capable of manufacture in large sheets. The use of this substance will not only greatly reduce the cost of installation of sun-power plants, but will make repairs a factor of but slight importance.

It may also be said that the large area covered by the sun-power plant would add greatly to the expense, but inasmuch as these plants are intended for use where the cost of land is very low, such criticism is not valid.

The future development of solar power has no limit. Where great natural water powers exist, sun power cannot compete; but sun-power generators will, in the near future, displace all other forms of mechanical power over at least 10 per cent of the earth's land surface; and in the far distant future, natural fuels having been exhausted, it will remain as the only means of existence of the human race.

The Current Supplement

THE rumor of the birth of synthetic rubber makes us look with renewed interest at those industries in which India rubber is worked up into various articles. A review of the Present Status of the Rubber Industry forms one of the principal topics in the current SUPPLEMENT, No. 1865.—The fifth instalment of Prof. Turner's article on The Great Star Map continues his discussion of the subject of star positions.—The length and character of wood fibers is a subject of interest both to the botanist and to those who carry on industries using wood as a raw material. The subject is discussed in a brief illustrated article. —Every now and again a seemingly new disease becomes fashionable. A case of this kind is appendicitis, which for some years past has sprung into remarkable prominence. The question naturally arises, is it really a new disease, or if not, how came it to escape our notice until recently? The discussion of this question by a French physician has appeared in *Cosmos*, and is reproduced in this paper.—A striking new development, along the lines of Lodge's classical experiments on Fog Dissipation, comes to us from California, where Prof. Cottrell has successfully applied electricity for the precipitation of fumes occurring in manufacturing processes. The report of his work, abridged from the *Journal of Industrial Chemistry*, is incorporated in the current issue.—The economies resulting from the use of lifting magnets in foundries are expounded by H. F. Stratton.—A simple electroplating apparatus is described.—A. Emerson tells of a newly discovered portrait of Constantine the Great.—Two short articles are devoted to phases in the plant industry, the one on the recovery of useful products from willow bark, the other on a device for testing cereals for their resistance to disease.—The second instalment of F. P. Valentine's valuable paper on Problems in Telephone Traffic Engineering appears in this issue.



Safety valve blowing off at one-half pound above atmosphere.

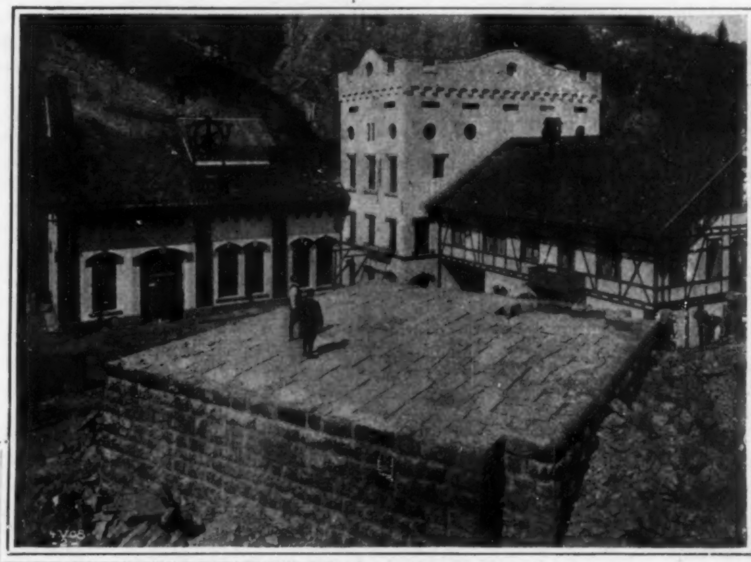
PRESSING THE SUN INTO SERVICE

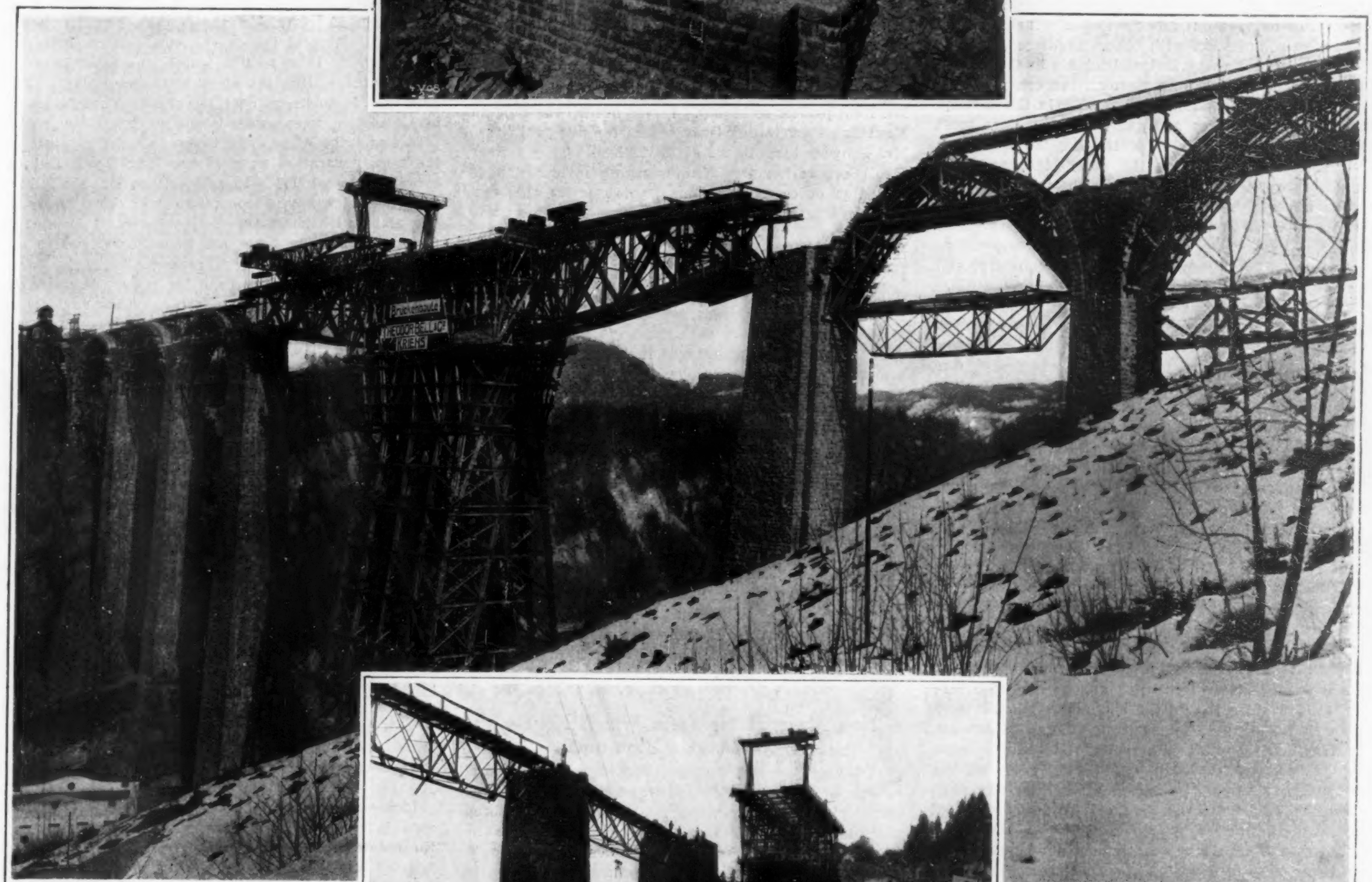
The Sitter Viaduct

A Remarkable Swiss Engineering Work

By the Paris Correspondent of the Scientific American

ONE of the most remarkable works in Switzerland, noted for its wonderful engineering structures, is the Sitter Viaduct. This is indeed the highest structure which the Swiss engineers have yet built. The viaduct lies on the line of a newly-built railroad known as the Bodensee-Toggenburg line, and is situated on the section of railroad lying between St. Gall and Watwil. It is built in a very picturesque site, where the Sitter torrent after joining the Urnasch stream, has worn down a deep cutting between the rocky faces of the adjoining heights. The railroad lies on the higher level, whence the need of a long viaduct in order to span the valley.



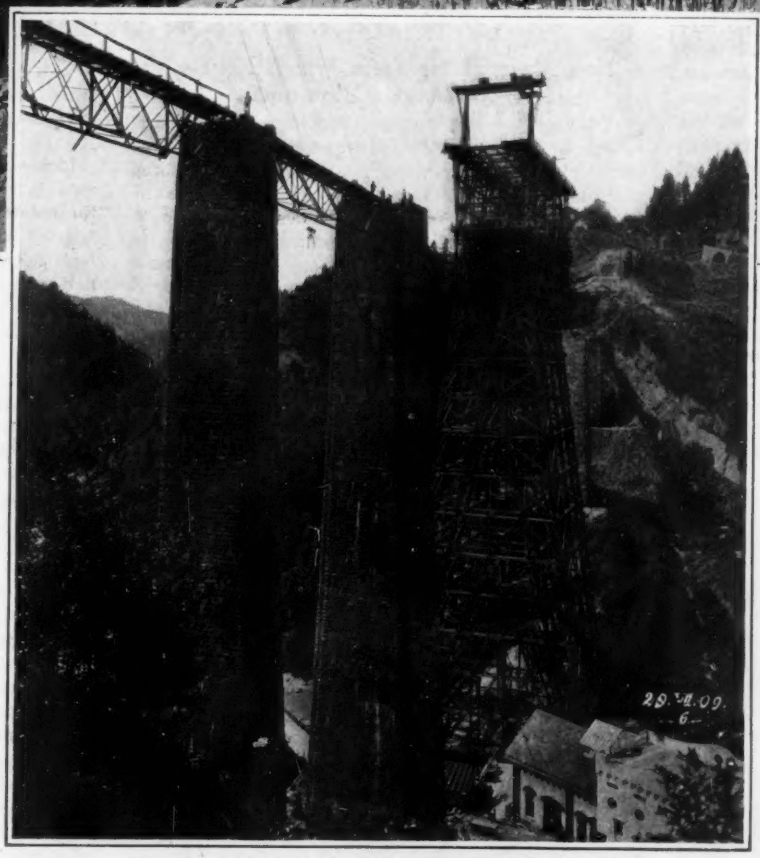


The great Sitter viaduct—eastern aspect.

The total height of the viaduct is 1,130 feet. There is a middle space of about 400 feet which is bridged over by a single steel truss noteworthy as being the longest in Switzerland. The engineers were obliged to resort to some very original measures on account of the local difficulties. The great steepness of the slopes of the valley allowed but little space for handling the material. There is no space on the upper ground at the left-hand end, since the mouth of the Sturzenegg tunnel is quite close to the steep bank. It was decided to use a system of cableways for handling the greater part of the material.

The main stone arches have 137 feet span, and several stone columns of unusual size enter into their construction. The highest of the piers is about 40 feet square at the base and runs up to 330 feet height. The viaduct has first four arches of 82 feet span, then comes the steel span, and on the other side there are two arches of 82 feet span and five small arches of 40 feet.

To build the steel truss high above ground a timber scaffolding of original shape was used. The base takes up but a small space. It was designed to stand the weight of the bridge truss, as well as the strong wind pressure. It sustained no damage despite storms and floods. An interesting operation was the construction of the truss span on the scaffolding. An electric elevator first installed on the lower platform and running to the top took up the iron parts for building a 12-ton cable hoist at the top level. When the hoist was in place it could be used to draw up the iron work which was needed in building the main bridge span. Meanwhile an air compressor plant had been installed for operating the pneumatic riveters for the bridge. In this way was built the middle part of the bridge truss to a length of 120 feet. Then came the task of building the rest of the length so as to reach the stone pillars on each side and cover the whole opening. In this case a good part of the truss overhangs the tower on both sides. The work was easily carried out by using a heavy traveling crane which runs on a track along the top level, as will be observed in one of our photographs. The crane had to be built on the top of the tower by material which was hoisted up from below. It could then be used in handling all the heavy iron parts in order to build the overhanging portions of the bridge on both sides of the tower, so that at last the ends of the truss could be placed upon the stone piers which were to support them.



The Sitter viaduct—view looking toward the tunnel.

A GREAT SWISS ENGINEERING WORK

Abstracts from Current Periodicals

Phases of Science as Other Editors See Them

Our Backwardness in Invention

WE recently reprinted from *Engineering News* some comments on the encouragement of invention in Europe and the discouragement of invention by the large corporations of this country. As the result of a rather lively letter written by Mr. William Kent, of Montclair, N. J., to the *Engineering News*, the editor of that paper takes up the subject again. In reply to the *Engineering News* statement that "We are to-day something like five years behind Germany in iron and steel metallurgy," Mr. Kent gives a list of improvements which have been made in blast furnaces, steel works, hoisting and conveying apparatus, foundry machinery, gas-producers, rolling mills, and machine tools.

The *Engineering News* recurs again to our backwardness in adopting the Diesel engine. "Notwithstanding the fact that the basic patents have expired so that any concern may build it, only a single firm in the United States to-day is selling Diesel engines," says the *Engineering News*, "and even this concern is not yet on a basis to push them on the market in competition with other machines.

"In oil engines, the principal business in the United States has been done by a German concern manufacturing an engine invented in England. In the development of gas-producers and suction gas engines most of the work done in this country has followed after the pioneer work done on the other side; and, notwithstanding the great stimulus to the use of the gas engine afforded by our stores of cheap natural gas, the internal combustion engine for power purposes is far more largely used abroad than here."

On the subject of the steel and iron industry, and the advance made by Germans, the *Engineering News* has this to state: "It is perfectly well known that the blast furnace gas engine . . . was fully developed and in successful commercial use in Europe about five years before it was taken up here." Our contemporary goes on to say that eleven years ago blast furnace gas engines were in use in Europe, which was about four years before the first blast furnace gas engines were installed at the Buffalo works of the Lackawanna Steel Company, cited by Mr. Kent as an example of American up-to-dateness.

In the electrical manufacture of steel, *Engineering News* points out that European inventors did the pioneer work, and that electric smelting furnaces were in extensive commercial use in Germany before American inventors thought it worth their while to take up this new invention.

"The pioneer American steam turbine inventor, Dow, lacked the commercial knowledge to make his invention a commercial success, nor was he able to secure capital to develop it. So the honors for pioneer work go to De Laval, the Swedish engineer, and to Parsons, the Englishman, while Curtis, another Englishman, and Rateau, a Frenchman, and Zoelly, a Swiss, and Riedler and Stumpf, in Germany, are the engineers who have won distinction in the later development of the steam turbine.

"As for the multi-stage centrifugal pumps and blowers, these were in extended and successful use abroad years before they were taken up in the United States. France developed the automobile far ahead of either England or America. Telferage was originally invented by an English professor of engineering.

"As for pioneer inventions in the railway field, the most important developments of the past five years in this country in locomotive design have been the Mallet locomotive (invented by the French engineer, Antoine Mallet, in 1888), and the use of superheated steam, for which credit must be given to the German, Schmidt."

In the opinion of our contemporary, "The United States no longer leads the world in the race for invention; but it is better to know the truth than to delude ourselves with false pretensions to supremacy.

"And now, as to the reasons why this country no longer leads. It is not because American engineers and inventors are less ingenious or less progressive than those of other countries, though it may well be that the thorough work done by the German technical schools gives them some advantage in the development of inventions requiring a high degree of scientific knowledge.

"We said in our former issue, and we now repeat, that the main reason, in our opinion, is that under the present organization of American manufacturing industry, invention and innovation is discouraged rather than encouraged. And this opinion is based, not alone on knowledge of the actual experience of numerous American inventors and engineers, but on the frank statement of officers connected with some of our large industrial corporations.

"We could cite the case of an American inventor who, after vainly endeavoring to secure capital for his work in his native country, went to England and won fortune, fame and honor. Another particularly pertinent example is the Gray beam mill, cited by our correspondent above as an example of American supremacy in pioneer inventions.

"The facts are that the inventor of the Gray mill for rolling wide-flange I-beams, after developing his invention and actually demonstrating its merits, was unable to market his invention with our excellent steel magnates. They were not *obliged* to have his invention. They were making money by the cartload in consolidation and promotion and stock market manipulation. Why should they bother with such a trifle as an improved system of rolling beams?

"Mr. Gray therefore went abroad, and the Belgium steel plant at Differdingen promptly took up his invention and developed a large and profitable business thereby. Returning to America after this success abroad, Mr. Gray was even then unable to secure a favorable hearing from the steel mill managers, whom Mr. Kent praises so highly. It was not till the Belgian plant had been rolling Gray beams for five years that Mr. Schwab took it up at Bethlehem. This former Steel Corporation president, engaging in a strenuous campaign of competition, may, perhaps, for this reason, have been more receptive to new ideas. At any rate, the success of the 'Bethlehem beams,' and the tardy imitation of these shapes by other American steel mills, justifies his venture and proved the ultra-conservatism of those managers who, years before, rejected the Gray rolling process.

"We are well aware that the huge industrial combination has some advantages in undertaking the development of new inventions over the small concern. We are aware that some of our trusts do maintain research departments and it is currently said that one important use of these departments is to defeat the independent inventor and discourage the undertaking of original invention in the field which the trust aims to control. We are well aware, too, that there are numerous lines of labor-saving machinery which have been developed in the United States, but not abroad, because of the great difference in wage scales here and there. All this has nothing to do with our contention that the United States has lost its supremacy as a field for the development of pioneer inventions, and that in the race of international competition we are falling behind because of the attitude of the trusts toward inventive progress."

A New Material for Safes Which Resists the Oxy-acetylene Blow-pipe

SAFE makers and safe breakers are engaged in a contest similar to that of the makers of guns and armor plate. Safe breakers' methods have lately been much improved, especially by use of the so-called autogenous welding process which makes it possible to penetrate iron and steel plates of great thickness in a short time by means of the oxy-acetylene flame. This advance in criminal practice has produced corresponding improvements in the construction of safes and vaults. Lately the well-known armor plate makers, the Krupps of Essen, have produced a new material which is especially suitable for the protection of safes and vaults, as, according to a note in the journal *Autogene Metalbearbeitung*, it cannot be fused or penetrated by the oxy-hydrogen, or oxy-acetylene burners now in use, or at least it offers so great a resistance to fusion that an inordinately long time and enormous quantities of gas are required. The material is a variety of cast steel which is extremely hard and resists the best boring tools, so that it affords security also against mechanical forcing. In order to make a hole 80 millimeters (3.2 inches) in a plate of this material, 40 millimeters (1.6 inches) thick, with the oxy-acetylene burner, from 6 to 14 hours time, from 2,750 to 4,550 gallons of oxygen and from 2,500 to 3,700 gallons of acetylene are required, according to the results of a number of experiments. The average safe breaker has not so much time or so much gas at his disposal. One of the steel cylinders in which compressed gases are transported contains about 1,400 gallons of (uncompressed) gas and weighs about 150 pounds. According to the most favorable results given above, at least four such cylinders would be required and their transportation, in addition to that of the other apparatus needed, is a task to stagger the boldest safe cracker. The extraordinary hardness of the plates opposes no serious obstacle to working them in the shop, as the rivet holes required can be made directly in the casting or they can be bored in softer steel parts especially provided for that purpose. The only defect of the plates is the present impossibility of making them thinner than 1.6 inches. It appears not improbable that this difficulty will be overcome, for only a year ago it was impossible to make the plates of less thickness than 6 inches, in which condition, of course, they were practically useless for the construction of safes and treasure vaults.

Heredity in Potatoes

IN the first number of *The Journal of Genetics*, a new journal devoted to problems in heredity, Dr R. N. Salaman gives some results of a prolonged study on the inheritance of certain characters in the common potato (*Solanum tuberosum*).

Mendelian behavior was found in the sterility of the pollen in certain varieties, the sterility being dominant. Most of the experiments related, however, to the tuber. In regard to length, the tuber behaves, in inheritance, like the stem of the pea plant. The long type is dominant over the short. That is, where two varieties were crossed, one having short round tubers and the other long tubers, all the potatoes of the next generation were of the long type. But on breeding these hybrids by self-fertilization, the following generation gave three plants with long tubers to one plant with short tuber, in the typical Mendelian fashion. The long tuber has more "eyes," which the author considers equivalent to nodes.

In some potatoes the eyes lie rather deep in the tuber, while in others they are near the surface, or quite on the outside. When these two characters are brought together in fertilization, the deep-eye character is dominant over the other.

The color of the tuber depends upon the amount of the pigment "anthocyan" present in the cell-sap of the superficial cells of the tuber, and varies from red to deep violet. On analysing the results of the experiments, it appears that there are three distinct factors that have to do with the color appearance of a potato. These are (1) a factor for redness, (2) one the purple or violet, and (3) a color "developer." Without this third factor no color appears at all. The other factors determine the character of the color. The purple appearance depends upon the presence of all three factors; this is dominant over the red, and this in turn is dominant over the white, or absence of pigment.

In the study of another species of potato (*Solanum etuberosum*) for comparison, Mr. Salaman found some curious results. In this species whiteness of tuber was dominant over pigmentation, roundness was dominant over long form, and superficial eyes dominant over deep-set. In all three respects this species is just the opposite of our garden variety.

Incidentally it was observed that the sterile individuals in every culture were much more resistant to the potato-rot (*Phytophthora infestans*) than the ones bearing fertile pollen. This is a mater of great practical importance, since it may be possible to establish a race quite immune to this disease. As the sterile individuals are dominant, this resistance would appear to be of a different type from the resistance of wheat to the wheat-rust (*Puccinia graminis*) which was found to be recessive in the Cambridge experiments. It is a simpler matter to establish a race bearing recessive characters, but it may be possible to find a combination of characters in a potato that will include immunity to the rot.

The Cost of Substituting Steel for Wooden Cars

ACCORDING to an estimate in the *Railway Age Gazette*, the cost of substituting steel cars for the present wooden cars is estimated at about $630,000,000. At the beginning of this year there were about 3,000 passenger cars in service in this country, built of all steel construction. The total number of passenger coaches is about 54,600 so that the number of steel cars is about 5.3 per cent of the total. Of the cars constructed during the present year, 62 per cent will be all-steel construction, so that at the end of this year fully 9.3 per cent of all passenger cars will be of steel, while 3.5 per cent have steel under-frames. The percentage of wooden cars in service has dropped in the last three years from 98.2 to 87.2 per cent.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Free Ships vs. Discriminatory Duties

To the Editor of the SCIENTIFIC AMERICAN:

The statement that the United States pays from $200,000,000 to $300,000,000 to foreign steamship lines for carrying passengers, freight, and mails is correct, with the sum nearer the $300,000,000 mark.

It is an economic fact also that under present conditions it is cheaper to pay foreign steamship lines for performing these services than to attempt it with American-built tonnage aided by subsidies or discriminatory duties.

Such a state of affairs is, in the long run, detrimental to all American interests. In the case of two European nations, if not three, their mercantile fleets are practically dependent on American traffic for existence. Our present system keeps alive our sea rivals and hinders the development of our export trade.

That the United States should be restored to their old position in the deep-sea trade, is imperative from a political as well as from an economic standpoint. Without an adequate merchant marine as an auxiliary to our navy, our battleship fleet is like a hull without an engine—only half equipped for its work.

We have a big navy, and it is growing larger all the time, yet it is as dependent to-day on foreign built and owned steamers for transports, colliers, etc., as it was when the Spanish war broke out. The United States paid some $20,000,000 or more then for the obsolete tonnage that foreigners dumped on Uncle Sam.

The views of Mr. Bowles, formerly an admiral of the United States navy, now president of the Fore River Ship Building Company, are entitled to great respect.

His company is building the two battleships for the Argentine navy, and it has turned out some high-class coast freighters. His statement, therefore, "the experience of sixty years of 'free trade' in ocean transportation conclusively shows that it is not profitable to American capital under present conditions, and requires protection or some form of government aid or subsidy," merits marked consideration.

Mr. Bowles seeks to overcome conditions of "free trade" which exists in the deep-sea trade by the application of "protective principles:"

"First, by mail compensation such as is provided for under the ocean mail act of 1891 and which is still in effect.

"Second, the remission of the head tax of $4 when immigrants arrive in the United States in American registered steamers.

"Third, by discriminatory duties applicable to American-built steamers of all types. . . . A reduction of 5 per cent on all goods on which the ad valorem duties exceed 41 per cent, and on all goods under 41 per cent or free the importer shall receive an importer's certificate available only for the payment of duties at the custom house and equal in value to 2.05 per cent of the value of the goods so imported."

The mail compensation act is still in effect, but it has done little good so far; it could be made of value in establishing new lines if American capital were generally employed in ocean shipping under the American flag.

The second proposition: the remission of the head tax of $4 when immigrants arrive in American steamers. It should be amended by establishing a stamp tax of $4 on all outward emigrant tickets, the same to be remitted in case the passenger sails on an American steamer.

Foreign governments do not hesitate to legislate to make the emigrant traffic a source of profit to the State and to the upbuilding of their merchant marine.

Third: The discriminatory duty. This is highly objectionable. The refund to the steamer or the importer would run from $2.25 per ton on sugar to $4.50 on a ton of coffee.

These articles, as well as hides, flax, fruits, fibers, are imported in cargo lots. An American steamer operated under such discriminatory duties would earn approximately 50 to 100 per cent more than a foreign steamer in the same trade. Under such conditions the American steamer would control the traffic in such commodities, and the control of the import would carry with it the control of the export, and subject exporters to such rates of freight as the traffic would bear.

It would almost to a certainty create a monopoly in the deep-sea trade as effective as now exists in the coastwise.

Although the United States have never tried the policy of "free ships" for upbuilding our merchant marine, the advocates of subsidy and discriminatory duties have always denounced it as a fallacy; yet those nations which have adopted it, are the most progressive and successful ship-owning nations.

For over one hundred years our shipbuilders have been shielded from the competition of foreign builders; this has resulted in developing our coastwise and lake shipping, but it has steadily lost us the deep-sea foreign trade till it is now practically extinct. In justification of this, it is stated that it costs from 40 to 50 per cent more to build steamers of the same size in American yards than in foreign. This would seem to indicate that the American prices are excessive.

It is also true that shipbuilding material may be imported free if used in building American steamers engaged in foreign trade. This privilege, however, is so hedged about with restrictions as to be practically valueless.

"Shipbuilder's (American) labor costs are 70 to 100 per cent more than the foreigner."

This is also equally true of labor engaged in making everything, from needles to automobiles, ship plates, and rails. Yet we are constantly exporting a greater quantity of all kinds of these and other manufactured goods every year. And if the American scale of wages can be paid on American goods sold in foreign markets in competition with goods of foreign manufacture, it would not be unreasonable to expect that our shipbuilders could compete with the foreign builder on steamers built for foreign trade only.

In the case of the two battleships being built for the Argentine government, it was done. The contract was secured in competition with foreign competitors, and it is to taken for granted that the labor employed in building these ships receives the American wage scale.

It is stated that to build the hulls of the battleships costs more in the American yards, but that Americans can turn out big guns and armor plates so much cheaper than can the foreigner, that the total cost of building in American yards is less than the foreigner's price.

It is something to be proud of—to be able to build armor and big guns cheaper than can European concerns; and as this is the case, it is somewhat difficult to see why steamers cannot likewise be built cheaper in American yards. The labor in gun and armor making is as well paid as labor employed in shipbuilding. A few years ago Krupp offered armor plate to the United States at much under the American prices. Now apparently American makers can undersell Krupp.

Justification for denying American registration to foreign-built, American-owned tonnage is that it costs more to operate the foreign-built under the American flag and that Americans would not avail themselves of the privilege.

Congress has been petitioned to pass such a bill, and assurances were given that on its passage a fleet of modern fast boats would be enrolled under the American flag for foreign trade. Yet Congress hesitates to pass such a measure, although no American interest could be injured in any way.

Another stated objection to the admission of "free ships" is that "the admission of foreign-built steamers would kill the art of shipbuilding in the United States." Well, as far as building for the foreign trade is concerned, it is dead now. It is some years since any steamers were built for trans-Atlantic trade, and the few built in the last decade were in many cases put under foreign flags and are now operated between European and American ports.

Holland, Norway, Sweden, Belgium, are countries with a small population and but little natural resources, yet owing to their free-ship policy they have fleets of merchant steamers that trade in every quarter of the globe.

Up to 1849 England had navigation laws similar to those of the United States. In that year they were repealed, and with their passing England's shipping began to expand till to-day she is far and away the most important shipping nation in the world.

Germany took pattern by England and also passed a free-ship measure which is still in effect, and her merchant marine began to expand; she has continued the policy of allowing German citizens to buy or build steamers in the cheapest market, granting German registration, to this day. In addition, all shipbuilding material is admitted free of duty into Germany.

This policy has placed her second among the shipping nations of the world, and it has aided the development of her shipyards; they have kept pace with the growth of the German tonnage, and to-day vie with England in turning out the largest and fastest steamers afloat.

France is the one European country that stands out pre-eminently as a believer in bounties for shipbuilders and subsidies for tonnage. Her policy has been in effect for years; she pays enormous sums annually in aid of her merchant marine, yet it is a negligible factor as compared with England and Germany, and hardly compares with many of the smaller countries.

The freight rates on French ships are higher than on tonnage of countries not subsidized, and tonnage of other countries has no difficulty in competing with the French, even to the ports of France.

The policy of subsidy and bounty followed by France may induce the building of steamers, but it does nothing to advance trade and commerce.

For our foreign trade we need a merchant marine, and to secure it we should have "free ships." It is pointed out by Admiral Bowles that to move one-third of our present foreign commerce, it would require *ten* years to build the necessary steamers—and the Panama canal is to be opened in 1915; possibly in 1913 according to Col. Goethals. At the outside, less than four years from now steamers will be using this canal.

A free-ship bill is the solution of the American merchant marine. It can do no harm to any American interest. Our yards build no tonnage for the foreign trade; even if they could compete to-day, they could do no more than keep pace with the ever-increasing demand for tonnage.

If it is necessary to subsidize to keep our shipyards going, let it be for steamers of the highest class and of high speed—20 knots at least; steamers that will be of value in case of war, and that can deliver mails and passengers to South American ports in quicker time than is now possible. Such steamers will do something to stimulate travel and intercourse between the nations of South America and the United States.

The great lines of traffic are operated by steamers of moderate speed and low cost of operation, and until we can build steamers of such a type as cheaply as foreign builders, Americans should be allowed to buy foreign-built steamers with the privilege of American registration, to ply in foreign trade only. With the passage of such a bill, tonnage under the American flag would rapidly increase and our commerce correspondingly expand, and not the least important benefit to follow, will be that our battle fleet will have an ample supply of colliers and transports.

Chicago, Ill. CHARLES DEPESEF.

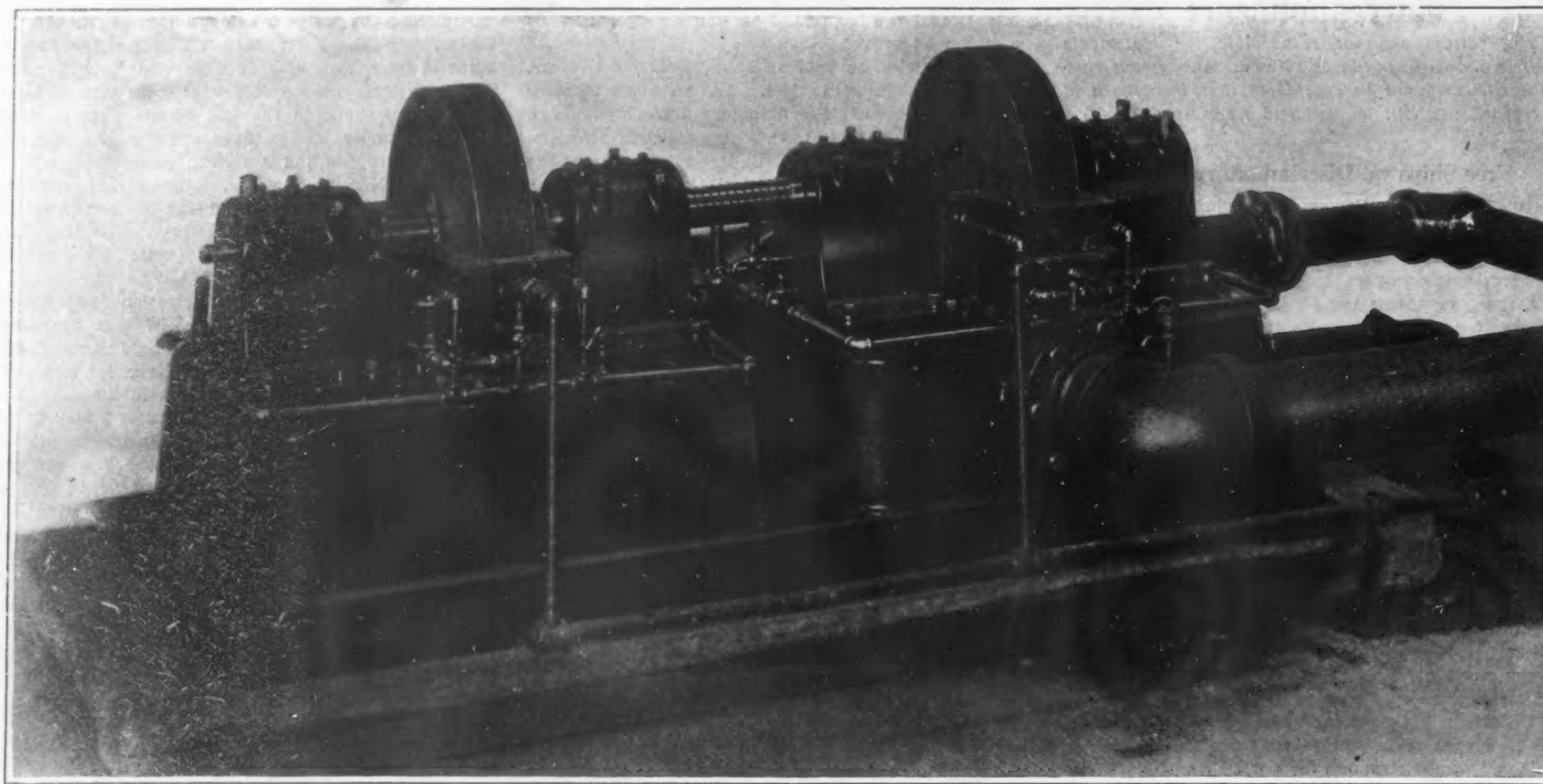
Oil as a Locomotive Fuel

THE advent of fuel oil has become an important factor in railway locomotion. It is estimated by the United States Geological Survey that from 20,000,000 to 25,000,000 tons of coal per annum are replaced by oil, and a large part of this is used by locomotives.

In this connection there is interest in a statement which will appear in the forthcoming petroleum report of the Geological Survey showing the extent to which oil is used as a locomotive fuel. The author of this report, David T. Day, computes the total length of railway lines operated during 1910 with petroleum as a fuel to be 21,075 miles, a trackage practically equivalent to that of five transcontinental lines stretching across the United States from ocean to ocean. The number of barrels of fuel oil used by the railroads (42 gallons per barrel) was 24,526,883. This includes 768,762 barrels used by the railroads as fuel other than in locomotives. The total number of miles run by oil burning engines during the year was 88,318,947. This would have carried one engine or train around the world approximately 3,530 times.

The advantages of oil as locomotive fuel over coal have been stated by Eugene McAuliffe as many. They include decreased cost of handling oil from cars to engines, with practically no loss by depreciation due to such handling; evaporation losses suffered by coal as not applying to oil; saving of time at terminals for engine cleaning and providing increased mileage per engine, the oil capacity of the tender being about 150 per cent of that of coal; freedom from physical failure of firemen in extreme hot weather; delivery of oil being unaffected by labor conditions, the coal situation necessitating in some instances heavy storage at great expense; greater cleanliness in handling all passenger trains, lack of smoke and immunity from right-of-way forest fires.

The expense of equipping the average locomotive to burn oil is about $800, and the cost of large steel storage tanks is about 25 cents per barrel; but the necessary terminal facilities for handling oil cost 50 per cent less than the amount required to handle coal.



The top half of casings is removed, showing two rotors. Each rotor consists of 25 disks ⅜-inch thick by 18 inch diameter. The steam enters at the periphery, and flows in spiral paths to exhaust at the center of the disks. The driving turbine is to the left, the brake turbine to the right. Between them is a torsion spring. The steam inlets are on opposite sides on the two rotors; the driving rotor moving clockwise. The torsion of the spring is automatically shown by beams of light and mirrors and the horse-power is read off a scale. At 9,000 revolutions per minute, with 125 pounds at the throttle and free exhaust, this turbine develops 200 horse-power. It weighs two pounds per horse-power.

The Tesla turbine testing plant at the Edison Waterside Station, New York.

The Tesla Steam Turbine

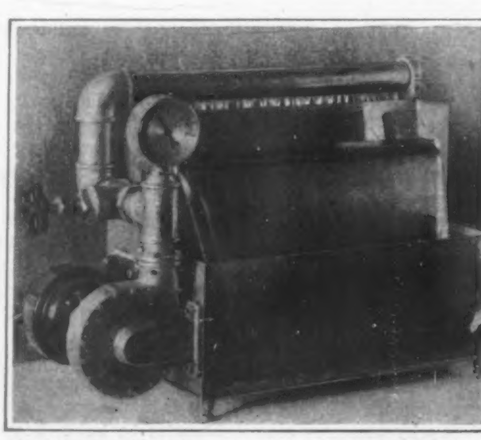
The Rotary Heat Motor Reduced to Its Simplest Terms

It will interest the readers of the Scientific American to know that Nikola Tesla, whose reputation must, naturally, stand upon the contributions he made to electrical engineering when the art was yet in its comparative infancy, is by training and choice a mechanical engineer, with a strong leaning to that branch of it which is covered by the term "steam engineering." For several years past he has devoted much of his attention to improvements in thermo-dynamic conversion, and the result of his theories and practical experiments is to be found in an entirely new form of prime movers shown in operation at the Waterside station of the New York Edison Company, who kindly placed the facilities of their great plant at his disposal for carrying on experimental work.

By the courtesy of the inventor, we are enabled to publish the accompanying views, representing the testing plant at the Waterside station, which are the first photographs of this interesting motor that have yet been made public.

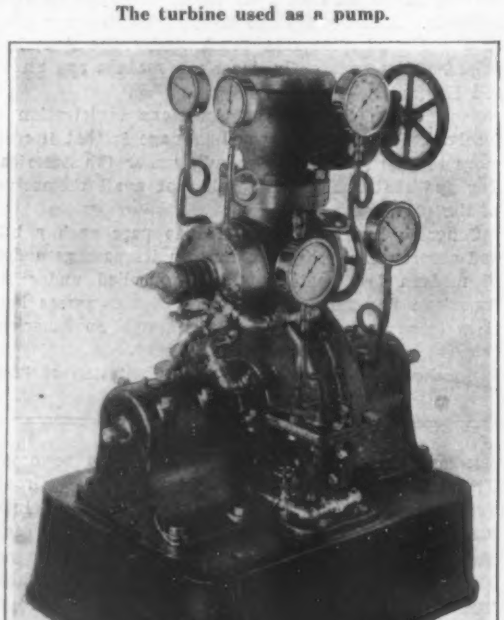
The basic principle which determined Tesla's investigations was the well-known fact that when a fluid (steam, gas or water) is used as a vehicle of energy, the highest possible economy can be obtained only when the changes in velocity and direction of the movement of the fluid are made as gradual and easy as possible. In the present forms of turbines in which the energy is transmitted by pressure, reaction or impact, as in the De Laval, Parsons, and Curtiss types, more or less sudden changes both of speed and direction are involved, with consequent shocks, vibration and destructive eddies. Furthermore, the introduction of pistons, blades, buckets, and intercepting devices of this general class, into the path of the fluid involves much delicate and difficult mechanical construction which adds greatly to the cost both of production and maintenance.

The desiderata in an ideal turbine group themselves under the heads of the theoretical and the mechanical. The theoretically perfect turbine would be one in which the fluid was so controlled from the inlet to the exhaust that its energy was delivered to the driving shaft with the least possible losses due to the mechanical means employed. The mechanically perfect turbine would be one which combined simplicity and cheapness of construction, durability, ease and rapidity of repairs, and a small ratio of weight and space occupied to the power delivered on the shaft. Mr. Tesla maintains that in the turbine which forms the subject of this article, he has carried the steam and gas motor a long step forward toward the maximum attainable efficiency, both theoretical and mechanical. That these claims are well founded is shown by the fact that in the plant at the Edison station, he is securing an



This little pump, driven by a motor of $\frac{1}{12}$ horse-power, is here shown delivering 40 gallons of water per minute against a 9-foot head.

The turbine used as a pump.



This view shows one complete high pressure unit, with the steam throttle above, and below it the reversing valve and the compact turbine. Note the many gages used in the tests.

A 200-horse-power high-pressure turbine.

output of 200 horse-power from a single-stage steam turbine with atmospheric exhaust, weighing less than 2 pounds per horse-power, which is contained within a space measuring 2 feet by 3 feet, by 2 feet in height, and which accomplishes these results with a thermal fall of only 130 B.T.U., that is, about one-third of the total drop available. Furthermore, considered from the mechanical standpoint, the turbine is astonishingly simple and economical in construction, and by the very nature of its construction, should prove to possess such a durability and freedom from wear and breakdown as to place it, in these respects, far in advance of any type of steam or gas motor of the present day.

Briefly stated, Tesla's steam motor consists of a set of flat steel disks mounted on a shaft and rotating within a casing, the steam entering with high velocity at the periphery of the disks, flowing between them in free spiral paths, and finally escaping through exhaust ports at their center. Instead of developing the energy of the steam by pressure, reaction, or impact, on a series of blades or vanes, Tesla depends upon the fluid properties of adhesion and viscosity—the attraction of the steam to the faces of the disks and the resistance of its particles to molecular separation combining in transmitting the velocity energy of the motive fluid to the plates and the shaft.

By reference to the accompanying photographs and line drawings, it will be seen that the turbine has a rotor *A* which in the present case consists of 25 flat steel disks, one thirty-second of an inch in thickness, of hardened and carefully tempered steel. The rotor as assembled is 3½ inches wide on the face, by 18 inches in diameter, and when the turbine is running at its maximum working velocity, the material is never under a tensile stress exceeding 50,000 pounds per square inch. The rotor is mounted in a casing *D*, which is provided with two inlet nozzles, *B* for use in running direct and *B′* for reversing. Openings *C* are cut out at the central portion of the disks and these communicate directly with exhaust ports formed in the side of the casing.

In operation, the steam, or gas, as the case may be, is directed on the periphery of the disks through the nozzle *B* (which may be diverging, straight or converging), where more or less of its expansive energy is converted into velocity energy. When the machine is at rest, the radial and tangential forces due to the pressure and velocity of the steam cause it to travel in a rather short curved path toward the central exhaust opening, as indicated by the full black line in the accompanying diagram; but as the disks commence to rotate and their speed increases, the steam travels in spiral paths the length of which increases until, as

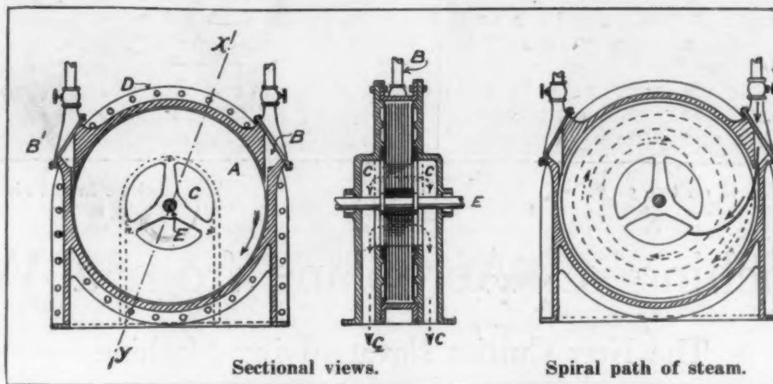
in the case of the present turbine, the particles of the fluid complete a number of turns around the shaft before reaching the exhaust, covering in the meantime a lineal path some 12 to 16 feet in length. During its progress from inlet to exhaust, the velocity and pressure of the steam are reduced until it leaves the exhaust at 1 or 2 pounds gage pressure.

The resistance to the passage of the steam or gas between adjoining plates is approximately proportionate to the square of the relative speed, which is at a maximum toward the center of the disks and is equal to the tangential velocity of the steam. Hence the resistance to radial escape is very great, being furthermore enhanced by the centrifugal force acting outwardly. One of the most desirable elements in a perfected turbine is that of reversibility, and we are all familiar with the many and frequently cumbersome means which have been employed to secure this end. It will be seen that this turbine is admirably adapted for reversing, since this effect can be secured by merely closing the right-hand valve and opening that on the left.

It is evident that the principles of this turbine are equally applicable, by slight modifications of design, for its use as a pump, and we present a photograph of a demonstration model which is in operation in Mr. Tesla's office. This little pump, driven by an electric motor of 1/12 horse-power, delivers 40 gallons per minute against a head of 9 feet. The discharge pipe leads up to a horizontal tube provided with a wire mesh for screening the water and checking the eddies. The water falls through a slot in the bottom of this tube and after passing below a baffle plate flows in a steady stream about ¾ inch thick by 18 inches in width, to a trough from which it returns to the pump. Pumps of this character show an efficiency favorably comparing with that of centrifugal pumps and they have the advantage that great heads are obtainable economically in a single stage. The runner is mounted in a two-part volute casing and except for the fact that the place of the buckets, vanes, etc., of the ordinary centrifugal pump is taken by a set of disks, the construction is generally similar to that of pumps of the standard kind.

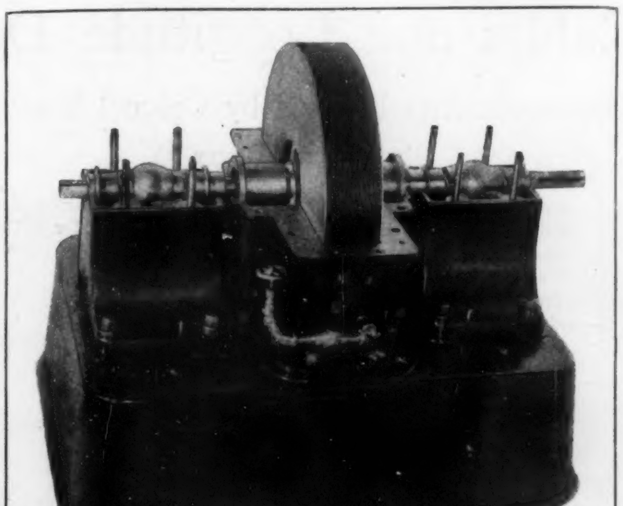
In conclusion, it should be noted that although the experimental plant at the Waterside station develops 200 horse-power with 125 pounds at the supply pipe and free exhaust, it could show an output of 300 horse-power with the full pressure of the Edison supply circuit. Furthermore, Mr. Tesla states that if it were compounded and the exhaust were led to a low pressure unit, carrying about three times the number of disks contained in the high pressure element, with connection to a condenser affording 28½ to 29 inches of vacuum, the results obtained in the present high-pressure machine indicate that the compound unit would give an output of 600 horse-power, without great increase of dimensions. This estimate is conservative.

The testing plant consists of two identical turbines connected by a carefully calibrated torsion spring, the machine to the left being the driving element, the other the brake. In the brake element, the steam is delivered to the blades in a direction opposite to that of the rotation of the disks. Fastened to the shaft of the brake turbine is a hollow pulley provided with two diametrically opposite narrow slots, and an incandescent lamp placed inside close to the rim. As the pulley rotates, two flashes of light pass out of the same, and by means of reflecting mirrors and lenses, they are carried around the plant and fall upon two rotating glass mirrors placed back to back on the shaft of the driving turbine so that the center line of the silver coatings coincides with the axis of the shaft. The mirrors are so set that when there is no torsion on the spring, the light beams produce a luminous spot stationary at the zero of the scale. But as soon as load is put on, the beam is deflected through an angle which indicates directly the torsion. The scale and spring are so proportioned and adjusted that the horse-power can be read directly from the deflections noted. The indications of this device are very accurate and have shown that when the turbine is running at 9,000 revolutions under an inlet pressure of 125 pounds to the square inch, and with free exhaust, 200 brake horse-power are developed. The consumption under these conditions of maximum output is 38 pounds of saturated steam per horse-power per hour—a very high efficiency when we consider that the heat-drop, measured by thermometers, is only 130 B.T.U., and that the energy transformation is effected in one stage. Since about three times this number of heat units are available in a modern plant with superheat and high vacuum, the above means a consumption of less than 12 pounds per horse-power hour in such turbines adapted to take up the full drop. Under certain conditions, however, very high thermal efficiencies have been obtained which demonstrate that in large machines based on this principle, in which a very small slip can be secured, the steam consumption will be much lower and should, Mr. Tesla states, approximate the theoretical minimum, thus resulting in nearly frictionless turbine transmitting almost the entire expansive energy of the steam to the shaft.



Sectional views. Spiral path of steam.

Details of turbine.



This turbine, whose rotor consists simply of a set of flat disks 18 inches in diameter, develops 200 brake horse-power on test.

Turbine with upper half of casing removed.

Some Striking Coal Facts

LAST year the United States mined 501,596,378 short tons of coal or nearly two-fifths of the year's total production for the world. This coal would load a train stretching back and forth across the United States from the Atlantic to the Pacific 33 times—a train approximately 100,000 miles long. Eleven years ago the United States for the first time surpassed Great Britain with a production of 253,741,192 tons, only a little more than half of last year's output. The mere increase of the coal output of the United States for 1910 over that of 1909—40,781,762 tons—was greater than the total production of any foreign country except Great Britain, Germany, Austria, Hungary, or France.

This increase alone was one and one-fifth times as great as the entire production of the United States in 1870. Excepting only Great Britain and Germany, either of the States of Pennsylvania or West Virginia produced in 1910 more coal than any foreign country. For the past seven or eight 10-year periods the coal production for each decade has been about equal to the entire amount of coal previously mined in the United States. Thus in the 10 years between 1885 and 1895 the production was 1,586,098,641 tons, while the entire amount of coal mined prior to 1895 was only 1,552,080,478 tons. In the 10 years betweeen 1895 and 1905 the production was 2,832,402,746 tons, while all the coal which had been mined prior to 1895 was 3,138,174,119 tons.

Incredible as it may seem, at the present rate of increase the ten-year period between 1905 and 1915 will show a production greater than all the coal mined in the United States prior to 1905. In 1850 the per capita production of coal was a little over one-fourth of a ton. In 1870 the per capita production had increased to nearly one ton; in 1890 it was 2½ tons; in 1900 it was 3½ tons, and in 1910 with the population of 91,972,266 the production was nearly 5½ tons for each person.

Last year 725,030 men mined coal in the United States. The great coal production record of 1910 was made in spite of a series of labor strikes participated in by 215,640 men. The loss in wages alone amounted to nearly $30,000,000.

The quantity of coal used for making coke in the United States for metallurgical purposes was 52,187,450 tons. This is additional to by-product coke produced in gas manufacture.

The total production of coal in the United States at the close of 1910 was 8,243,351,259 short tons. This plus the estimated loss incident to mining makes a total exhaustion of 13,395,000,000 tons. The United States Geological Survey estimates the original supply of coal in the ground in the United States, exclusive of Alaska, at 3,076,204,000,000 tons. This original supply less the exhaustion at the close of 1910 leaves an apparent supply still available of 3,062,808,972,000 tons, or 99.6 per cent of the original supply. In other words, in all the time since coal mining began in the United States the draft upon the original supply including loss in mining, has amounted to less than one-half of one per cent. At the present rate of production of approximately half a billion tons a year the coal reserve of the United States would therefore last 6,000 years. At the present rate of increase in production, however, these three thousand billion tons of coal in the ground would last only a few generations.

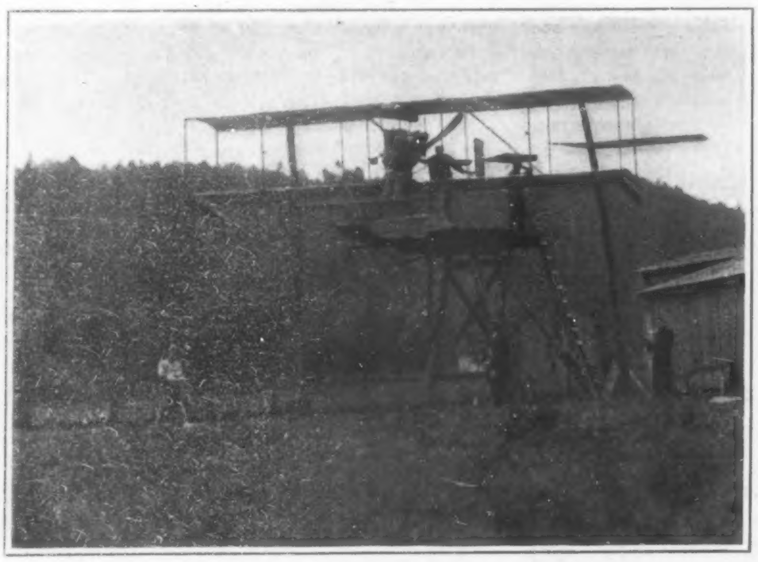
Foreign Students in America

ADDRESSING the House of Representatives on the many new activities of the United States diplomatic service, Representative Foster, of Vermont, late chairman of the House Foreign Affairs Committee, recently called attention to the effort made by our diplomatic and consular representatives to advertise the United States as an educational center, an undertaking that has been fruitful of results.

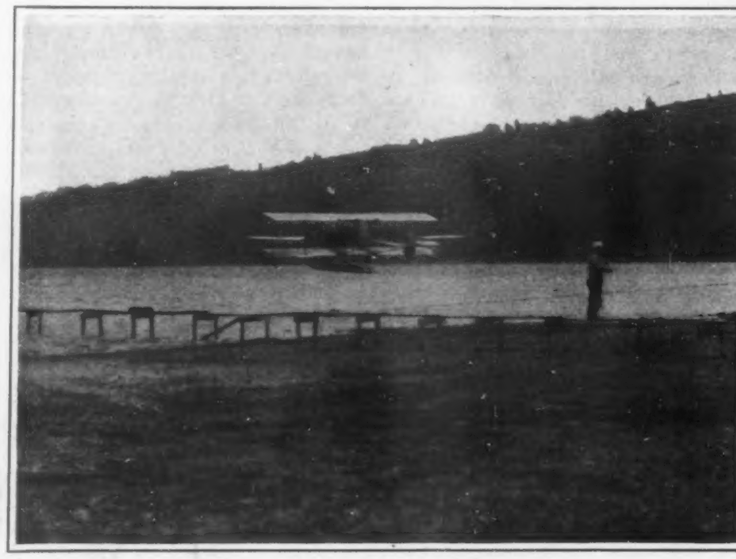
One of the outcomes of this program was the formation in Buenos Aires two years ago of a United States University Club, which has been the means of sending at least 20 young Argentinians to this country to be educated. Under the auspices of this club lectures are given on university life in the United States, illustrated with a large number of appropriate stereopticon views. Negotiations are now under way for an interchange of schoolboys between the Boston High School of Commerce and the preparatory department of the University of La Plata. There are now at least 400 Latin Americans studying in the United States, and the number is steadily increasing.

Through the efforts of our ambassador at Constantinople, supported by the State Department, Columbia University has voted to receive, free of all tuition charges, three students annually from the Ottoman Empire for the next ten years, to pursue courses of study in any of the departments of the university. These students are to be selected by the Ottoman government, with the advice and approval of the ambassador at Constantinople.

The education of Chinese students in America, a matter in which the United States government has always taken a kindly interest, is assuming ever larger proportions. These students now number between 800 and 900. Half of these are "government students," supported by the different Chinese provinces, and by the remitted portion of the Boxer indemnity fund. To insure that the indemnity students coming to the United States should not start with a serious handicap, but be fully prepared to enter the American colleges, an academy has been established in Peking by the Chinese government, where these students receive preliminary instuctions under American teachers.



The biplane on the wire, balanced on two guys.



The machine in the air after leaving the wire.

Launching an Aeroplane from a Wire

The New Curtiss Naval Flying Machine

BY far the most serious problem which confronts the Navy Department in its effort to utilize aeroplanes is the difficulty of providing a suitable launching and alighting gear. Every one knows nowadays that before it can really fly, an aeroplane must be in motion; that, like any soaring bird, it must make an initial run in order to get up speed. Alighting on land has always presented its difficulties; indeed, it may be safely said that the landing chassis as we know it is capable of much improvement. How much more difficult must it be to land on water?

The first experiments which were made in our navy with the aeroplane involved the use of a rather extensive platform on the forecastle of the scout cruiser "Birmingham." Down this platform, at a fairly steep angle, Ely in a Curtiss biplane, ran on November 8th of last year, and for the first time in history succeeded in launching a flying machine from the deck of a warship. Two months later he succeeded in starting from and alighting upon the "Pennsylvania."

Remarkable as this achievement was, it is obvious that warships cannot carry about with them platforms of such size. In action, every piece of unnecessary apparatus, every incumbrance, is simply tossed overboard. The platform unquestionably would have to go with the rest, if the ship is to be fought at all.

Mr. Glenn H. Curtiss seems to have succeeded in overcoming these difficulties, by adopting the hydroplane construction. He has shown that it is possible both to start from the water and to alight upon it with comparative ease and safety. In a word, he devised a type of flying machine peculiarly adapted to the needs of the navy.

The problem of providing a suitable launching gear, which can be used when the water is too rough for the hydroplane float, seems now to have been solved with equal felicity. At Hammondsport, on Lake Keuka, Curtiss has been making experiments which show that it is possible to launch a hydro-aeroplane from a wire cable. Perhaps the most successful trials were made by Lieut. Ellison. According to Mr. Curtiss, it would only be necessary to stretch one wire from the boat deck of a battleship down to the bow. On this cable the hydroplane glides down, being kept from falling by two auxiliary wires which support the wings until the machine gets up sufficient headway to keep its own balance by means of the ailerons or other control.

Such a launching gear does not interfere in any way with the guns or armament and can be stowed away after it has served its purpose in a very short time.

The experiment shows that whenever the sea is too rough to permit the hydroplane to rise from the waves, it can always take the air by means of the cable.

Submarine Cables and Longitude Determination

The Improvements Devised by Colonel Bourgeois

By Jacques Boyer

AN accurate comparison between two astronomical clocks, situated at a great distance from each other, can be made by overland telegraphy, by means of which the time signals given by both clocks are recorded, side by side, on an electric chronograph at each station. The ordinary electric chronograph is provided with two pens, or writing points, operated by electro-magnets, so that each pen makes a distinctive mark on the same uniformly rotating cylinder or moving strip of paper, when the circuit of its electro-magnet is made or broken. Usually one pen marks the time by the local clock, while the other records signals made by the observer, on the passage of a star over the wires of the transit instrument or the occurrence of any other event. For the determination of longitude, the electro-magnet of the second pen is connected with the clock at the distant station.

In order to determine the difference of longitude between two stations by this method, it is necessary to transmit from each station to the other currents

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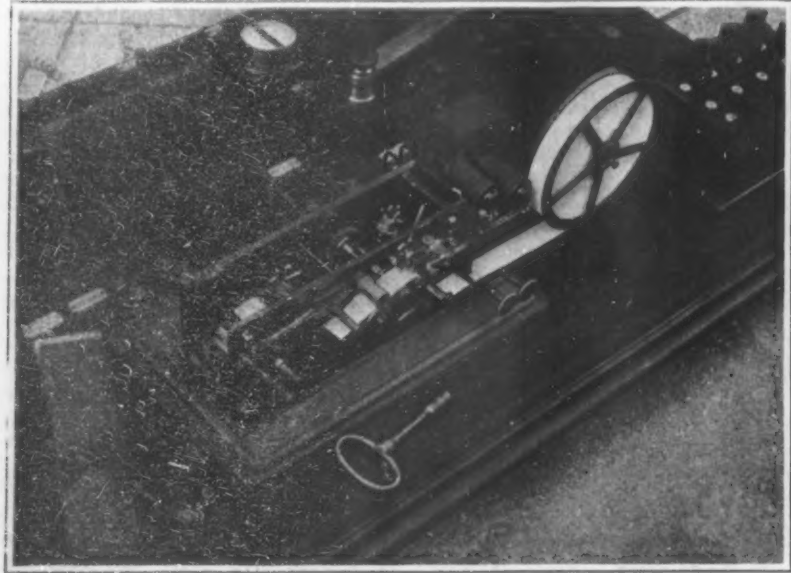
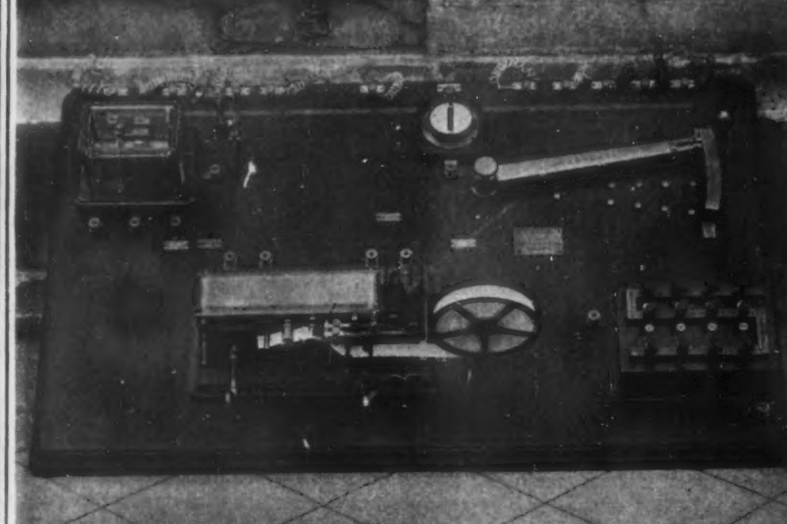


The double chronograph.



Apparatus for determining longitude by cable.

THE EMPLOYMENT OF SUBMARINE CABLES IN THE DETERMINATION OF LONGITUDE

Current Astronomical Events

Brooks's Comet; The Harvest Moon

Brooks's Comet

How to Find It Without the Aid of a Telescope

By S. A. Mitchell, Professor of Astronomy at Columbia University

THERE is hardly a person anywhere who is not interested in a comet, and at the present time one is visible each night without the aid of a telescope. Moreover, it is not at the limit of visibility to the naked eye, but one which can be readily seen by anyone who cares to spare a few minutes watching for it.

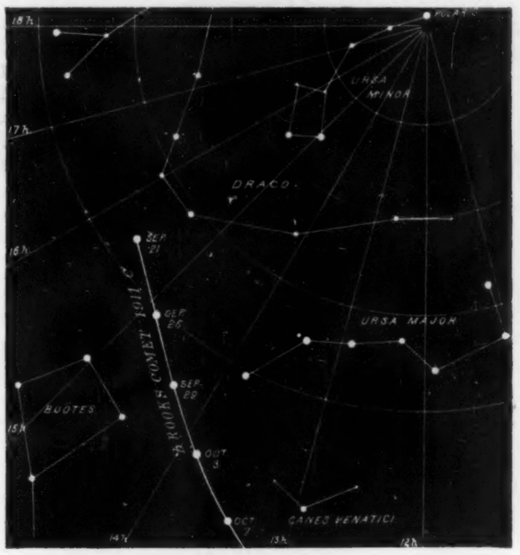
The comet known to astronomers as Brooks's, or Comet 1911c, was discovered on the night of July 20th by the famous comet-seeker at Geneva, N. Y. When discovered, it appeared as a faint hairy star, without a tail, entirely unlike the popular idea of a comet. Observations on this and the following few nights gave astronomers the opportunity of calculating its path with respect to the sun, and in relation to the earth. These calculations furnish an ephemeris which gives the position in the sky where the comet may be found. Such a calculation is a laborious piece of work, which must be done with great precision, and with care that no mistakes are made in the additions and subtractions. Ordinarily when a comet is discovered a parabolic orbit is first computed, for this calculation is the easiest and presents the fewest difficulties. Such an orbit is quite an impossible thing in astronomy, but on account of the simplicity, it is adopted because it gives the position of the comet near enough for all practical purposes.

If the comet is an interesting one, or if it is the return of one formerly discovered, then the more difficult elliptical elements are calculated. In the case of Halley's comet, this was an exceptionally difficult undertaking, for the "perturbations" or attraction of the various planets led to serious complications.

Several sets of calculations have been made for Brooks's comet, one of the most reliable being that of F. E. Seagrave of Providence, R. I. The ephemeris for the end of September and beginning of October follows:

Date.	Right Ascension. h.	m.	s.	Declination. deg.	m.	s.
September 21st	15	31	15	+53	0	39
September 25th	14	51	17	49	21	7
September 29th	14	17	44	44	58	56
October 3rd	13	49	52	40	6	42
October 7th	13	26	46	34	51	0

The amateur with his small telescope and circles can readily find the comet from this table. Right ascension and declination in the sky correspond to longitude and latitude on the earth. A ship at sea is located by knowing its longitude and latitude, or New York city is found by knowing that its longitude is 74 degrees west, and its latitude 40 degrees 48 minutes north. The stars are kept track of by means of their right ascensions and declinations. As we can locate Philadelphia from the fact that it is ninety miles in a certain direction from New York, so we can locate the comet from its position with respect to the stars without paying attention at all to the figures which give the right ascensions and declinations.



The path of the Brooks comet.

On September 2nd a photograph by Prof. Barnard exhibited a tail eight degrees in length, which corresponded in extent to 10,000,000 miles. At the same time the head measured 500,000 miles across. The comet was closest to the earth on September 17th, when it was readily visible as a fourth magnitude star. It was then forty-eight million miles away from us. Steadily the comet is speeding toward the sun, the great central luminary which exerts its attractive influence on all bodies of the solar system. On October 27th, the comet will be at perihelion, when it will be 45,000,000 miles distant from the sun, which is as close as it will approach that body. At the middle of September, the comet was a circumpolar object at 57 degrees north declination. Its motion has been southwest more than a degree each day.

On September 30th, the comet will be as bright as the fifth magnitude and can be quite easily found near the end of the handle of the "Big Dipper." The handle takes a crook in it at the well-known double star Mizar. Follow from Mizar to the end of the handle, and in a straight line five degrees farther on, the comet may be seen; or in other words, the comet will be about half way between the end of the handle of the "Dipper" and the third magnitude star Gamma Bootis. The comet will set about 10 o'clock. One should look for it immediately after sunset (though the moon will interfere somewhat) before the comet gets too near the horizon. The comet's rapid motion makes it set earlier each night, so that on October 7th it sets at 9 P. M. It will soon set as early as the sun when it will become invisible—to be seen later in the month before sunrise.

Though the head of the comet has been quite bright, its tail has been difficult to see in the telescope because it is so faint. It needed a long exposure to photograph the tail.

The world is still waiting for a brilliant comet to appear, one which may be seen in the sky in spite of the electric lights of the city and without special diagrams, one which will rival the great comet of 1882.

The Harvest Moon

By Frederic R. Honey, Professor of Astronomy at Trinity College

THE term "harvest moon," originating in England, where the brilliant moon-light of several consecutive evenings aided the harvesting of crops, is the popular expression for the moon at its full in the month of September in northern latitudes. This phenomenon of early moon-rise is dependent upon the degree of retardation of the moon's rising, as affected by difference in latitude. As conditions in England are especially favorable, full moon-rise at harvest time therefore occurs earlier than in the lower latitudes of this country. Following out this law of retardation, it is a matter of course to look for a yet earlier rising of the "harvest moon" in the far north of the Scandinavian peninsula; and an extremely opposite condition in the corresponding latitudes of the Southern hemisphere, where the "harvest moon" (if it were possible to use the term in this region) would occur about the time of the vernal instead of the autumnal equinox.

Variations in the retardation of the moon's rising (a retardation which averages about 51 minutes daily) are due to complex conditions. If the earth's axis were perpendicular to the plane of the ecliptic, and if the earth and moon revolved in circular orbits at uniform velocities around their respective centers of motion in that plane, the retardation would obviously be constant. But the earth's axis is inclined at an

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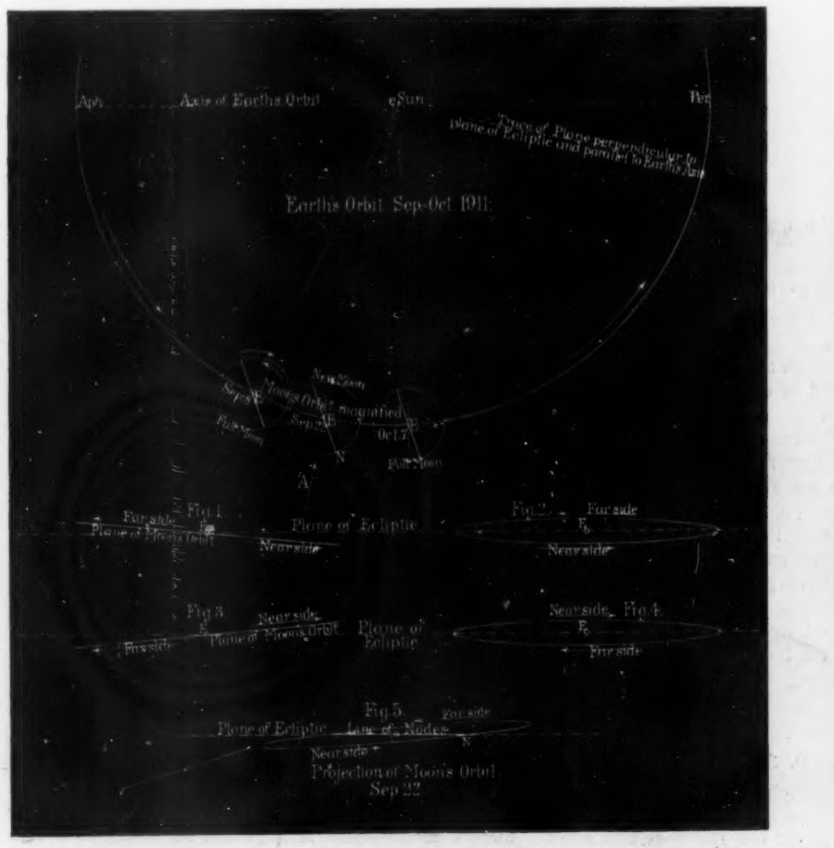
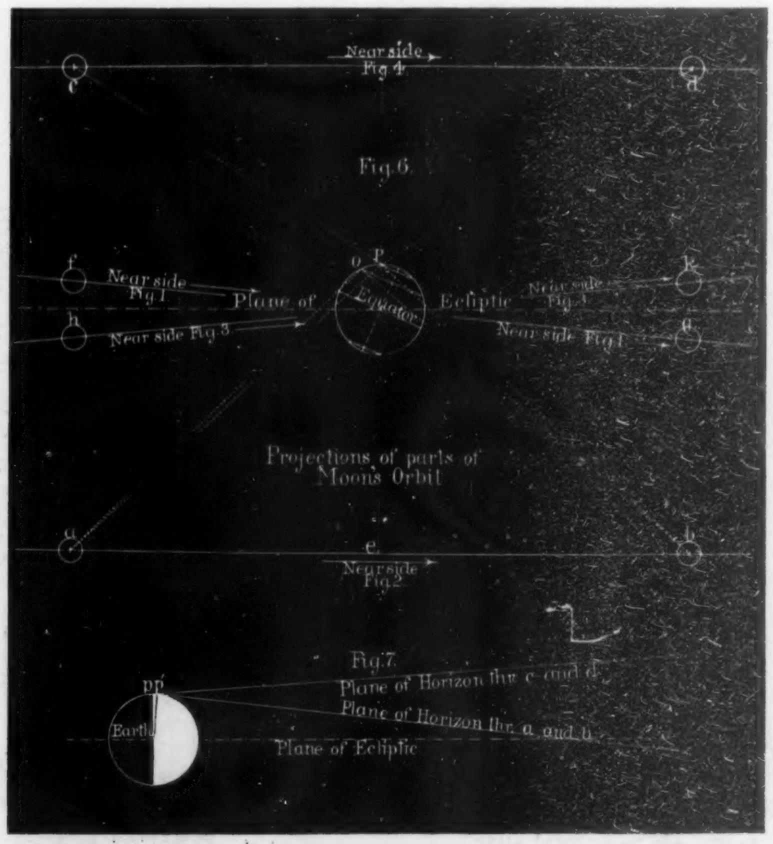




The motion of the moon in its orbit during September and early October.

The Laboratory

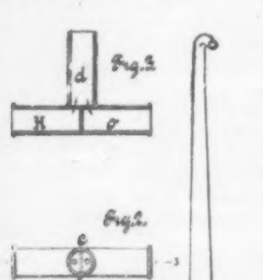
Some Suggestions for Home Experiment

The Amateur's Oxy-hydrogen Blowpipe

By A. J. Jarman

SO many interesting experiments may be performed with the oxy-hydrogen blowpipe that it is almost an essential of the amateur's laboratory. With it not only may any of the metals (platinum and iridium not excepted) be fused, but earthy bodies as well may be combined with various metallic oxides. The blowpipe illustrated herewith was designed by the writer, and used for many years. The construction is very simple. Procure a swivel joint, such as is illustrated in Fig. 1. If a joint of that exact type cannot readily be found, the amateur may devise one from the fittings of a gas light bracket. This joint should be firmly secured to a base of hard wood, such as mahogany. An ordinary brass blowpipe, of the type used in the mouth, should be secured to the swivel joint, as indicated at *a* in Fig. 1. The best way to do this is to cut off the lower end of the blowpipe with a triangular file, twist a piece of copper wire around the end, and press it into the joint, and then secure it by soldering it with soft solder. The joint should be air-tight. The other part of the swivel joint should be fitted with a device such as illustrated in Figs. 2 and 3. It consists of a piece of brass or copper pipe, of ⅜-inch outside diameter. With a hack-saw make a cut in the pipe at the middle, as indicated at *b*, *c*, Fig. 2. Insert a small strip of brass or tin plate in this cut and solder it firmly in place, making sure that the joint is air-tight all around, so that the pipe is divided into two separate compartments. Drill two small holes in the tube, one at each side of the tin partition. Then solder a nipple *d* to the brass tube, so that it fits over the holes just referred to. In every case the soldering should be so done as to prevent leakage of gas or air at the joints. The nipple *d* should be screwed into the swivel joint, as indicated in Fig. 1. The two sections of the pipe may be connected by rubber tubing to the oxygen and hydrogen sources of supply. In order that the rubber tubing may be firmly held to the brass pipe, it is best to solder a ring of brass wire to the edge, forming a flange.

The hydrogen (carbureted) may be obtained from a gas bracket after removing the tip or burner. The other side of the tube, marked *o* in Fig. 3, should be connected to the oxygen supply, which may either be a cylinder of compressed oxygen, a gas holder, or a gas bag. In use, first turn on the hydrogen or the coal gas and light it at the nozzle of the blowpipe. Then gradually turn on the oxygen. The two gases will commingle in the nipple *d*, and in the swivel joint, and the presence of the oxygen in the gas will immediately be attended by a reduction of the length of the flame. Turn on the oxygen slowly until a very brilliant bluish green flame protrudes from the blowpipe nozzle. This will indicate the hottest flame obtainable from the mixture. In case of an excess of oxygen, the mixture will ignite within the blowpipe, producing an explosion, which, however, will not be of serious proportions. A piece of battery carbon forms a very good fusion plate upon which the material to be treated may be placed. Slate dust, graphite, glass powder, and many of the metallic oxides, may be fused with this blowpipe. A small quantity of powdered borax aids the fusion of the oxides. Metals of any kind may be welded together, even platinum. The blowpipe may be used to produce a brilliant limelight by letting the flame impinge upon a stick of common lime, mounted on the end of an iron wire rod, and shaped with a file with a hole at the center of the cut drilled with a brad awl. A light of from 200 to 400 candle-power can thus be produced, with which excellent photographs may be taken at night.



A home-made blowpipe.

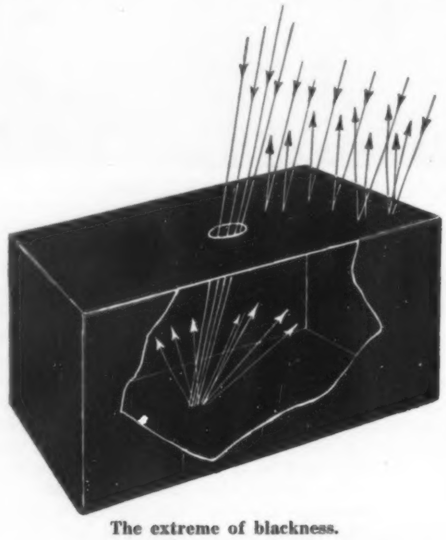
Experiments can also be made with blocks of magnesia, zinc oxide, oxide of zirconium and compounds of these and other infusible oxides, all of which will give a brilliant light of varying color generally without fusing. Dissimilar metals can be joined in the form of wire without special fluxes. Should a flux be required, borax answers the purpose very well, or boracic acid. The fusing together of different metallic oxides by the aid of boracic acid flux will often produce excellent imitations of precious stones.

An excellent illustration of the explosive properties of a mixture of oxy-hydrogen gas can be shown by blowing soap bubbles with the blowpipe, and allowing the bubble to float in the air; then apply a lighted taper. The report upon ignition will be deafening. A soap bubble blown at the tip of the blowpipe, and the gas supply cut off will act in the same way, but it is better if it be allowed to float in the air.

The Standard Black

By A. L. Hodges

THE question often arises, What is pure black? Teachers of physics say that black is an absence of all color—that is, no matter what light falls on a pure black substance none will be reflected, all being



The extreme of blackness.

absorbed. There is no such substance known to man which will do this thing but, as usual, ingenuity has overcome this disadvantage. The standard of blackness and, than which none can be blacker, is simply a hole in a black box. The physical reasons for this are easy to see. The only condition necessary is that a minimum number of rays of light shall be reflected from the standard of blackness. To show the advantage of the hole we will contrast the rays reflected from the black face of the box with the number coming out of the hole. Let a ray beam of light strike the face and hole normally or obliquely. The face at once shows itself lighter than the hole for this reason: The rays striking the face are diffusely reflected in every imaginable direction and at every imaginable angle, consequently an eye in front of the face will receive a certain number of these diffusely reflected beams. But now consider the rays that go through the hole and that strike the back of the box (also painted black, and of a rough surface, as is the face). These will also be reflected in every imaginable direction and *for that reason* the majority of them will not come out of the hole but be caught on the inside of the face being either absorbed or reflected again. So if a fewer number of rays come out the appearance will be the more black to the eye, as the eye only "sees" when a ray of light enters it. Illustrations of this principle are common. If one looks into an open window of a house on a very bright day, even, the window looks simply like a black hole—the light getting in is not reflected back again in near the amount of entering, even though the inside wall be of the same color as the outside wall.

Air Apparatus for Amateurs

By John D. Adams

COMPRESSED air has such a wide application in experimental work and in so many of the arts that it may not be amiss to point out the possibilities of ordinary bicycle supplies in this line of work.

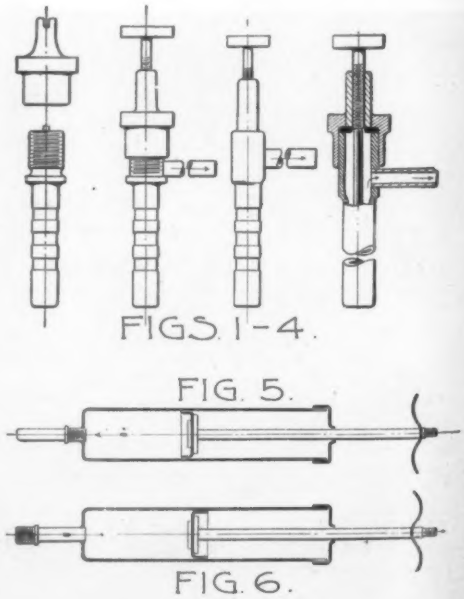
Considering its cost, lightness, and simplicity, the ordinary ten-cent bicycle pump is a remarkable piece of apparatus. If we desire a moderate supply of compressed air to operate, for example, an air brush or a torch—it is only necessary to solder a bicycle valve to a suitable tank and connect our pump. But, you say, how are we to get the air out of the tank? In Figs. 1 to 4 is shown the method of converting a bicycle valve into a needle valve—and an excellent needle valve, too, because when it comes to holding air it is hard to beat a bicycle valve. It will retain air for months. The valve in Fig. 1 is drilled at the base of the threaded portion, and is provided with a small brass tube, fitted into the drilled hole and securely soldered. The cap is drilled through the top and threaded for a screw, which, when screwed far enough down, pushes the little valve stem down and thus lets the air escape. A very small leakage may occur around the rubber gasket in the cap, but this is negligible, as it occurs only when the air is being drawn. If cutting threads is an inconvenient operation, procure an ordinary nipple and spoke. File off the top of the cap, drill a hole in its top, fit on the nipple and secure it with solder. The resulting cap will then be as in Fig. 2. Cut off the threaded end of the spoke and solder on a round cap, so as to form a suitable screw.

The somewhat neater valve shown in Fig. 3 may be made by filing off all the threaded portion of the original valve and discarding the cap entirely. The small side outlet tube is provided as before, and the nipple is fitted and soldered directly into the top. The regulation of the air supply is very sensitive.

If three ordinary ten-cent bicycle pumps are arranged so as to be operated from a crank shaft with a fly wheel, we obtain a small triplex pump of good capacity and very uniform delivery. In such arrangements it will usually be found more satisfactory to make the delivery from the lower end instead of through the hollow piston rod, in which event the latter must be soldered up and the lower end provided with a suitable outlet tube. Where it is not practicable to have the valve attached to the air tank, solder it to the lower end of the pump, as in Fig. 5.

Fig. 6 shows the ordinary bicycle pump changed into a vacuum pump. The cup leather is reversed, the piston rod is closed, and a valve is soldered to the lower end in the position illustrated. It is hardly necessary to remark that such a pump will not produce a high vacuum, but it will compare very favorably with the best piston pumps, and will be found useful in many experiments requiring a greatly reduced air pressure.

Sometimes tin cans, such as groceries come in,



Air apparatus made of bicycle supplies.

will serve as air tanks, but if the pressure is rather high choose one having a length of two or more diameters and brace it by running some straight bicycle spokes clear through and soldering them tight at the ends.

The Inventor's Department

Simple Patent Law: Patent Office News: Inventions New and Interesting

Mechanical Advertising Novelties

Of the many ingenious schemes employed in advertising, none have proved more effective than the various mechanical devices which various inventors have turned out from time to time. The public in general loves a mystery, and a device which apparently contravenes some general law of nature is sure to receive much attention. In Fig. 1 is shown an apparatus, recently patented, which has been quite successful as an advertising novelty. It consists of a bottle suspended in an inclined position and from its mouth there pours a constant stream of liquid into a tank. As there is no visible means for replenishing the liquid in the bottle, one would naturally expect it soon to become empty, but the level of the liquid in the bottle remains the same. Nature's laws, however, have not been upset, for in the center of the stream is a glass tube of the same color as the liquid and, hence, invisible. The lower end of this tube is connected with a pump and the upper end extends up into the bottle so that the pump is constantly withdrawing liquid from the tank and forcing it up into the bottle, whence it pours out around the glass tube, thus rendering it invisible. So perfect is the illusion, that no hint can be gained from a working device as to the secret of its operation.

A clock, keeping excellent time and consisting of a plate of glass on which is painted a dial, a bolt passing through the center of the dial and forming an axis for hands, with no apparent place for a clock movement, will always attract much notice. Recently an ingenious jeweler in a West Virginia lumber town constructed one, using a pane of glass, and wood for the hands. Many a lumber jack spent hours conjecturing how it worked. It made no difference in which position the hands were placed, they would promptly revert to their proper position. The wooden hands were carefully covered with tinfoil, so as to conceal the watch movements inclosed therein. The balancing of the hands was accomplished by an ingenious system of shifting weights. A number of clocks of this type have been patented, one of the cleverest being shown in Fig. 2. The enlargements in the hands house the watch movements and the shifting counterweights.

Fig. 3 shows a clever apparatus for attracting attention. All that the spectator sees is a flat-topped box on which a large ball rolls round and round but never falls off. The force moving this sphere is invisible. The sphere is but a thin shell, and inside this shell is a small metallic ball which is free to move about the inner surface of the large sphere. Inside the box is a magnet which is rotated by a small motor. As the small ball endeavors to follow the magnet, it causes the large sphere to roll about the box lid.

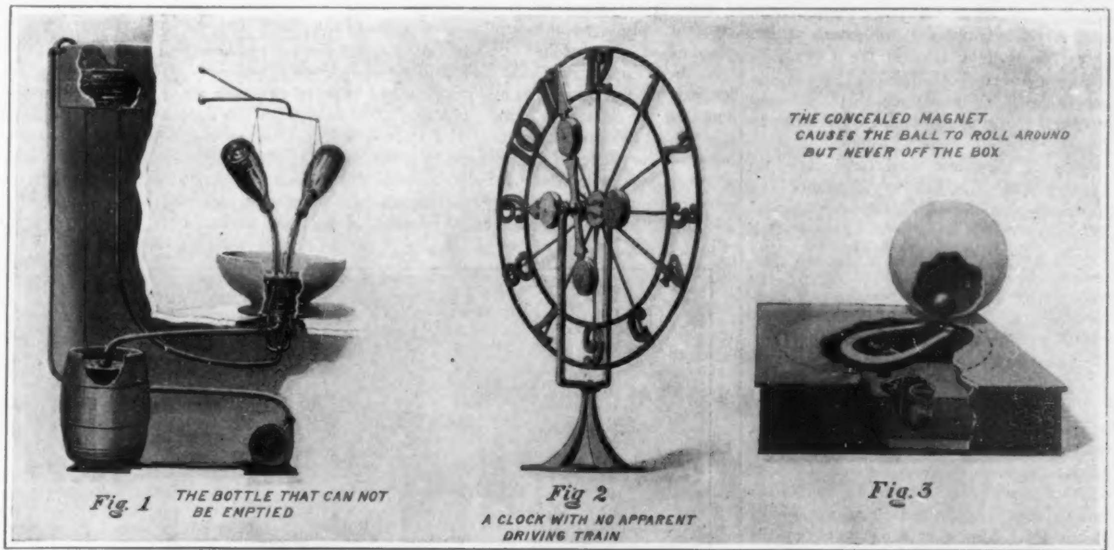


Fig. 1 THE BOTTLE THAT CAN NOT BE EMPTIED

Fig. 2 A CLOCK WITH NO APPARENT DRIVING TRAIN

Fig. 3

For calling attention to the excellence of a certain brand of soap, the device shown in Fig. 4 was designed. This shows a very grimy figure descending from a chimney into a basin, from which he emerges clean and white. The two figures, however, are on separate endless belts which are driven by a hidden motor.

Most people imagine that the wooden Indian has a monopoly of the tobacco sign business, but he has a competitor in the dummy which ostensibly smokes a cigar. The cigar, however, is likewise a dummy and the smoke comes from a concealed pot of burning tobacco and is intermittently expelled from the lips of the dummy by concealed bellows. One of the most elaborate of these signs, which was recently patented, appears in Fig. 5. This is a hollow crescent figure, whose convex face is studded with incandescent lights, and bulbs are also arranged in the eyeholes and at the outer end of the cigar, held in the mouth of the figure. At the back of the figure is a box containing a small motor which operates mechanism for intermittently turning on and off the lights, and simultaneously with the turning on of the lights, to blow smoke out through the mouth of the figure.

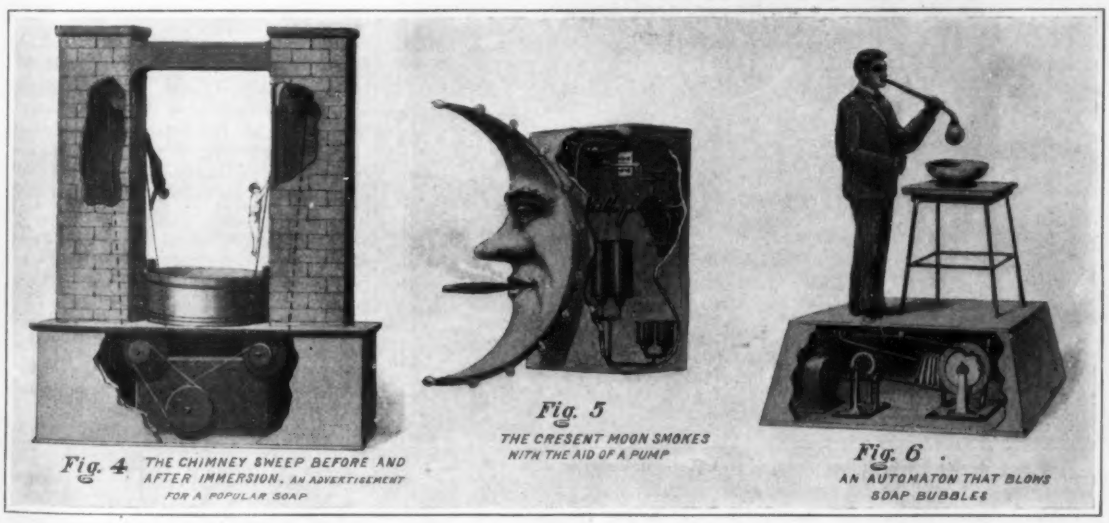


Fig. 4 THE CHIMNEY SWEEP BEFORE AND AFTER IMMERSION. AN ADVERTISEMENT FOR A POPULAR SOAP

Fig. 5 THE CRESENT MOON SMOKES WITH THE AID OF A PUMP

Fig. 6. AN AUTOMATON THAT BLOWS SOAP BUBBLES

The blowing of soap bubbles is an occupation usually accorded to children, but an automaton for doing this has been patented (see Fig. 6). This figure dips his pipe in a bowl of soap suds, then raises his arm and at the same time a current of air is turned on for blowing the bubble. Then the air is cut off and the fan, which is held in the other hand, is waved and the bubble is blown off into the air. The bellows and the mechanism for working the various levers and the valve are located in the box on which the automaton stands.

The combination of a flower and butterfly (Fig. 8), is designed for the display of precious stones. By means of a clockwork mechanism, a cavity in the flower is alternately opened and closed and at the same time the wings of the butterfly moved and the petals of the flower are moved.

Nothing is quite so comforting to a hungry man on a cold day as the steaming dishes of food displayed in the windows of restaurants. Many a dyspeptic has come to grief when a steaming dish of corned beef and cabbage has been brought to his attention in this manner. A close examination of the dish would have disclosed a cleverly concealed steam pipe, running from some distant boiler and discharging through the bottom of the dish like the coffee cup shown in Fig. 7. Fig. 9 shows how this idea has been utilized for displaying effervescent wines. The stem of the wine glass is hollow and in the lower end is placed a porous plug, through which air is forced by a concealed pump. The pressure must be small in order that the air may rise in minute globules, thus imitating sparkling champagne. A concealed reservoir is also connected with the hollow stem so as to keep the liquid in the glass at a constant level, for a considerable part of the liquid will be lost in evaporation.

The advertising value of novelties of this kind is unquestioned and one is surprised, in looking for patents on this art, to find that the number is so small. Their


Fig. 7 THE DECEPTIVE CUP OF STEAMING COFFEE

Fig. 8 A MECHANICAL BUTTERFLY

THE GLASS OF IMITATION CHAMPAGNE Fig. 9

MECHANICAL ADVERTISING NOVELTIES

cost of production is generally so small, compared with the huge and elaborate signs now in use, that it would seem that inventors would find this a profitable field of endeavor.

A Fireman's Smoke Protector

By Herbert T. Wade

It is a popular fallacy that a fireman can be trained to endure almost any degree of smoke, thanks to the frequent use in the daily press of such terms as "smoke eaters." Beyond certain limits even the fireman is unable to withstand smoke, and it interferes greatly with his fighting fires at close range, especially in cellars. Consequently, for many years there has been a demand for a practical smoke helmet or other device that would supply fresh air or oxygen to the fireman at work in an atmosphere impossible to breathe.

Though they are used extensively in Europe and supplied to a number of American fire departments, such devices have never found wide favor in the United States, where they are regarded by many firemen as cumbersome and of limited utility. Nevertheless, American firemen have been anxious to find suitable apparatus of this nature, and the investigations of mine rescue experts with such appliances have been observed with interest.

The fireman demands a light weight device that shall be simple and reliable, ready at a moment's notice, yet easy to adjust and manipulate. Under conditions where a line of hose may be used, this has been secured in a recent invention by James D. Halloran of the New York fire department, which tested in actual service at a fire on September 19th, has been found to work with great success. It consists of an auxiliary line of hose connecting with the outside air, through which pure air is drawn by the passage of the water through the nozzle of the main line of hose, and distributed by means of tubes connecting with a rubber piece covering the nose and mouth of the fireman like the nose guard of the football player. The device involves a cylindrical brass piece or collar, which is screwed on the end of an ordinary control nozzle, such as is found in the equipment of any hose wagon. To this is attached a brass pipe about three feet in length which opens on the main bore, through which the stream passes, and connects with the air supply hose already mentioned. From this brass pipe are taken three flexible pipes which terminate in the rubber face pieces held by the teeth.

When the water in the main line of hose passes through the nozzle it sucks or draws the air from the outside through the small hose, so that it is available in abundance for breathing through the flexible pipes, so long as the water is flowing. The principle is very much the same as the familiar water-blast pump of the laboratory, and the application seems to be no less successful. Its particular usefulness will be in cellar fires, where dense smoke is usual and gives great trouble to firemen. Here combustible rubbish is responsible for many serious fires, which often could be more promptly extinguished were the firemen able to get directly at the seat of trouble, instead of being forced to use cellar pipes directed from above.

It is of further interest that this new device was supplied to a double section hose company in the high pressure district whose equipment now represents the last word to be said in fire department practice, and to this organization also has been assigned the fireman inventor. This company has to deal with many cellar fires and the new smoke protector will not only have the surest possible trial but will be greatly appreciated by the firemen themselves. Changing conditions in fire fighting demand improvements in apparatus and methods, and the mechanical training now being received by firemen is bound to produce many ingenious inventions, of which Mr. Halloran's smoke protector is a sample.

Notes for Inventors

Aluminium Pulleys.—One of the big machinery concerns of this country recently made some pulleys of aluminium to meet some special conditions required by one of its patrons and the innovation proved to be such a desirable one that more were made at once and now they have been adopted as standard by that particular concern. They are said to have many advantages over those of cast steel. It is necessary to make some slight departure from the usual shape but this is a very trivial matter.

The Telautograph in Desks.—Telautograph machines, which reproduce a written message at more or less distant stations, have been introduced into desk drawers, for use by bank presidents and public men, enabling the latter to make inquiries of clerks and secretaries without the knowledge of the caller. It is possible to write a message under these conditions and receive an answer concerning the personality or business of the individual seated at one's elbow, without leaving the desk or seeming to make any inquiries.

A new device for enabling firemen to enter smoke-laden atmospheres.

A Striping Machine.—Striping is a branch of the painter's art which requires special qualifications and the man who has a reputation for good striping has no fear of losing his job. Carriages, motors, machinery, farming implements and a great variety of similar articles are not regarded as properly finished if they are not striped. This has always been done by hand, the painter using a long haired brush, but the greatest essentials to the work is a steady hand and a good eye. Thus equipped, he becomes so expert that he makes a straight line better than others do with a straight-edge. A hand device has been recently invented for performing this work, and it greatly facilitates the task for the reason that the painter is enabled to do twice as much work in a given time. The apparatus is designed on the principle of the fountain pen. It fits in the palm of the hand and is supplied with a bulb by which the flow of paint is controlled. A number of interchangeable wheels are supplied with the striper and with these it is possible to make a great variety of stripes as well as small borders, such as walls of Troy, oak leaves and similar designs.

A Safety Device for Trolley Cars.—A trolley car which cannot start while a passenger is in the act of alighting or boarding the car has been in experimental use for a short time at Portland, Me. Such a feature will prevent most of the accidents which railway companies are compelled to pay damages for, and if successful, will meet with immediate adoption wherever the open end cars are used. The invention consists of a hinged step which is depressed a distance of a half an inch by a weight of less than ten pounds. This depressed position of the step has the effect of breaking an electrical circuit connected with the contractor and the latter fails to close by any act of the motorman while there is any weight on the step. The same principle has been applied to the elevator which will prevent that kind of accident which is so common, that of the car starting when a person is just in the act of entering it, the prospective passenger being crushed between the car and the wall of the building. A section of the elevator floor at the entrance yields slightly under the weight of a person and this throws into action a safety device which prevents the starting of the car.

Bricks That Float.—At the present time there is no particular demand for a brick that will float but such a thing will be regarded as a curiosity the world around. In the development of a special brick, designed to be used as an insulation in the construction of cold storage plants, breweries and refrigeration plants and is meant to take the place of cork, flax, charcoal fiber and sawdust, all of which are imperfect insulating materials, the use of which is attended by foulness and rot or are otherwise offensive. The brick, in waterproofing, is so burned that 45 per cent of its volume is confined air, with the result that one of these bricks being cast upon the waters, will float along like a block of wood.

A New Letter Box.—The latest suggestion for letter boxes is one made of pressed steel, without any ledges or places in which a letter might become lodged in its interior. This is a trouble which exists despite the greatest care. Many letters are delayed or fail of delivery entirely by being caught inside the letter box and securely held there. Another feature of the new box is that it has a drop bottom, which is almost as great a consideration to the postal authorities as the smooth interior, for it permits a box filled with hundreds of letters to be emptied as quickly as another containing but a few letters. The carrier's receptacle is swung under the box and the bottom opened so that all letters drop at once down into the bag without any possibility of loss or delay.

Another Worthington Pump Patent Expires.—The patent to Charles C. Worthington, No. 526,429, having issued September 25th, 1894, expired on September 25th, 1911. This patent involves the gradual closing of the valves at the end of the plunger stroke and enables a pump to be driven by a direct-acting steam engine with an increased velocity and avoids wear and tear upon the valves by slamming. Worthington has later patents still in force among which are Nos. 584,533, 584,534, No. 607,902 of July 26th, 1898, and No. 657,976 of September 18th, 1900. The original Worthington pump patent, No. 24,838, was issued July 19th, 1859, to Henry R. Worthington and included two direct acting pumping engines propelled by steam or other fluid and so arranged that each engine actuated the inlet and outlet valves governing the motive power of the other, thereby insuring the constant action of at least one pump piston upon the water and relieving the action of the pump from shocks and concussions. This was one of the most important pump patents ever issued and the invention was a valuable contribution to the art to which it relates.

Metal Cloth.—An entirely new product, which takes up a position about midway between artificial silks and the fibers hitherto known which have been made from metal, has just been placed upon the German market by a well-known Elberfeld firm. In contradistinction to the metal fibers so far known, Renar yarn does not consist of a metal core or main-thread spun round with tinsel; it is a core, made of any suitable medium which, by means of a special chemical process, is entirely covered with a metallic coating which becomes thoroughly incorporated with the core. At the same time all the metallic lustrous particles are so embedded in the external coat that they are protected against atmospheric or other extraneous influences, and thus maintain their sheen or luster for an indefinite period. The yarn is not only produced in the original colors of gold, silver, copper, old gold, etc., but is supplied in any modern shades required; all these colors are characterized by a fine, striking metallic luster which will not fail to please, and which are reminiscent of silk and metallic lustrous combinations. The yarn can also be worked up with artificial silk. From experiments made, it is fully proven that this new yarn is perfectly "fast," that is to say, it retains its color and never gets black or oxidized.

Patents to Former Examiners.—Among the patents issued on August 15th, 1911, is one, No. 1,000,414, to Charles J. Kintner of New York city, for a hose connection, and another, No. 1,000,476, to Oscar Woodward of Montclair, N. J., for a typewriting machine. Both of these inventors were formerly principal examiners in the United States Patent Office, and a patent, No. 1,000,435, for a valve, was issued on the same day to Edward N. Pagelsen of Detroit, Mich. Mr. Pagelsen was also, at one time, a member of the examining corps of the Patent Office.

RECENTLY PATENTED INVENTIONS.

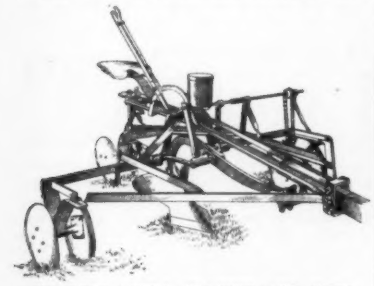
These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

COMBINED SCARF, SHAWL, AND SWEATER.—J. ADLER, New York, N. Y. This invention relates to clothing, and the object is to provide a wrap which may be used as a shawl or scarf, and when desired may be readily converted into a sweater. The combined scarf, shawl and sweater may be manufactured at very little expense and may be conveniently used in a number of ways to protect the body of the wearer.

Of Interest to Farmers.

COMBINED LISTER, PLANTER AND RIDGE BUSTER.—SAMUEL B. HAMILTON, R. 2, Wakefield, Kan. This inventor provides a mechanism which may be adjusted to space the operation of a lister plow to form parallel ridges; provides a frame for an implement of the character specified, having strength, lightness and durability; provides carrying wheels



COMBINED LISTER, PLANTER AND RIDGE BUSTER

arranged to cause the wheels to track toward the center of furrows, to form a revolving wedge the rearward spread whereof bears against the sides of furrows and prevents the drift of the wheels and implement, and provides a simple, durable and economical frame structure. The illustration shows a perspective view of the implement, constructed in accordance with Mr. Hamilton's invention.

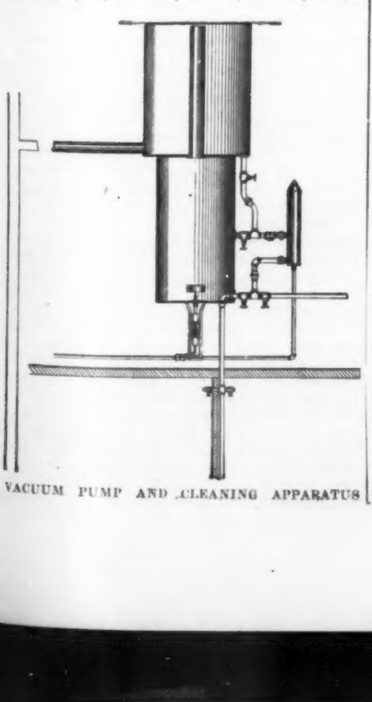
SPRING GUARD ATTACHMENT FOR CORN HARVESTERS.—J. H. BREEN, Eden Valley, Minn. The invention provides an attachment which may be secured directly to the under side of the dividers, which is in the nature of a spring guard for preventing inclining of the stalks in their movement toward the binder table, or rather for holding them in vertical position. It may be attached to the under side of dividers of ordinary corn harvesters without interfering with the working parts thereof.

Of General Interest.

MOLD FOR MAKING CONCRETE ARCH BLOCKS.—W. C. HOLDEN, Scarboro-on-the-Hudson, N. Y. In the present patent the object of the invention is the provision of a new and improved mold, more especially designed for making arch blocks, and arranged to permit convenient adjustment of the mold parts for making blocks of different sizes for arches of different spans.

DISPLAY CARTON.—A. M. BOOS, Boston, Mass. This invention relates to display cartons, and has reference more particularly to a device, comprising a back, sides, a front, a top having an opening to receive the articles to be displayed, and an inclined bottom having gaps adapted to engage the lower ends of the articles, to assist in holding the same in position.

VACUUM PUMP AND CLEANING APPARATUS.—L. L. MONTGOMERY, 2509 Oaks Avenue, Superior, Wis. This invention pertains to an improved system for obtaining a vacuum by hydraulic pressure, whereby cleaning by vacuum may be accomplished, and which may be reversed to form, to a certain extent, a hydraulic air-compressing pump. A further object is to provide a system in which hydraulic means creates a vacuum or pressure, with means for automatically controlling the hydraulic means by the vacuum or pressure created. The device is simple in construction and inexpensive to manufacture, and is illustrated herewith in vertical section showing a fragmentary portion of the system in operation.



VACUUM PUMP AND CLEANING APPARATUS

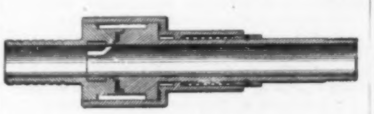
Hardware and Tools.

STRIKING LINE.—HENRY K. KISO, 214 E. 20th Street, Manhattan, New York, N. Y. This invention relates to striking lines used by carpenters, bricklayers, and other artisans, for the purpose of marking straight lines upon rough or irregular surfaces. It comprehends a disk-like casing in which is revolubly mounted a drum, and upon this drum the line is wound. The unwinding turns the drum in one direction,

STRIKING LINE

the drum being retracted by a spring. The casing is provided with a sector-like opening and fitting into this opening is a hollow door through which the line is drawn, and disposed within the hollow door is the inking apparatus. This patent is for sale. The device is illustrated herewith and is shown in perspective ready for use, the line being partially unwound.

HOSE COUPLING.—FRITZ A. SCHNEIDER, 403 E. 179th Street, Bronx, New York, N. Y. The object here is to provide a coupling, arranged to permit quick coupling and uncoupling of the members, at the same time insuring a tight joint with a view to prevent leakage when the members are coupled. For this pur-

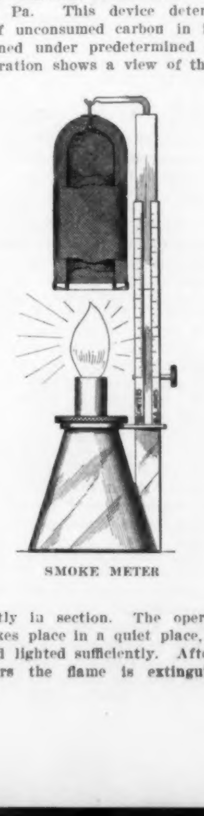


HOSE COUPLING

pose use is made of coupling members, of which one is provided with a bayonet slot, and a spring-pressed locking device mounted to slide on one of the coupling members and provided with a key adapted to engage key-ways standing at an angle to the slot and stud. The plan view of the hose coupling as applied is pictured in the engraving.

Heating and Lighting.

SMOKE METER.—FREDERICK W. MANN, Franklin, Pa. This device determines the amount of unconsumed carbon in illuminants when burned under predetermined conditions. The illustration shows a view of the improve-

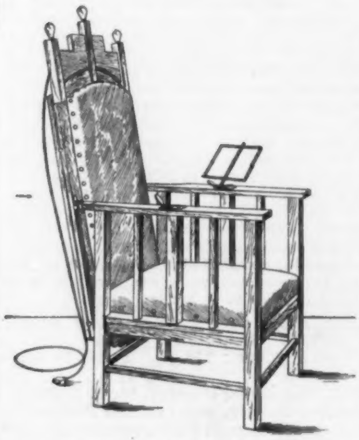


SMOKE METER

ment, partly in section. The operation preferably takes place in a quiet place, free from drafts, and lighted sufficiently. After burning three hours the flame is extinguished, the mantles removed, and brought to normal temperature, preferably in an exsecator, as is also the reservoir and the remainder of unconsumed oil. The reservoir and unconsumed illuminant are then weighed separately to ascertain the exact amount of illuminant consumed, and the net weight of unconsumed carbon is found by the difference in weight between the mantles before and after use.

Household Utilities.

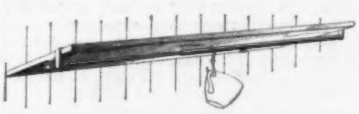
CONVERTIBLE CHAIR AND TABLE.—ISRAEL HOFFMAN, 86 Lenox Avenue, New York, N. Y. The invention provides a convertible chair and table, arranged to permit of conveniently and quickly changing the table into a chair and *vice versa*, and when in the form of a chair a book rest is provided for reading purposes, electric lights for the proper illumination of the reading matter, and a receiver for



CONVERTIBLE CHAIR AND TABLE

cigar or cigarette ashes, burned matches, etc. The frame has arm rests, chair seat, combined chair back and table top provided with means to swing the back and table top onto the top of the arm rests, to provide a table, or to swing it into position to form a chair. The accompanying illustration shows the convertible chair and the table set up to form a chair.

CRYSTAL CLOSET BRACKET.—RACHEL JASPER, Borough of Manhattan, New York, N. Y. The accompanying engraving is a perspective view of this invention applied to a glass shelf. The invention relates to a new and improved form of depending bracket, and is particularly adapted to form a bracket for

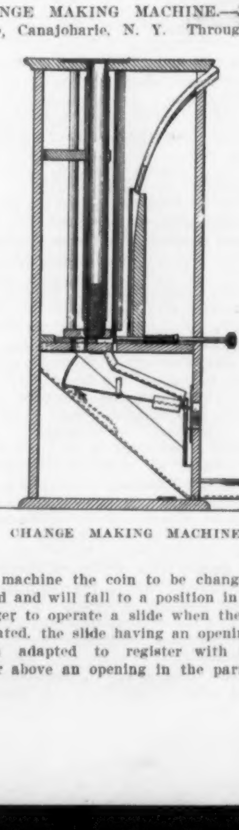


CRYSTAL CLOSET BRACKET

a glass shelf such as used in crystal closets, where it is inconvenient or impossible to attach a supporting means for the bracket directly to the glass. By means of her improved bracket, a means is afforded whereby cups or other articles may be suspended beneath the glass shelf without in any way interfering with or modifying the construction of the glass shelf.

Machines and Mechanical Devices.

CHANGE MAKING MACHINE.—JOHN R. CONRAD, Canajoharie, N. Y. Through a slot



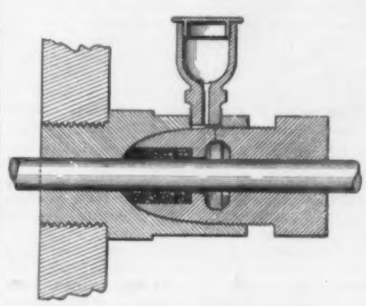
CHANGE MAKING MACHINE

in the machine the coin to be changed is introduced and will fall to a position in front of a plunger to operate a slide when the plunger is actuated, the slide having an opening therethrough adapted to register with the coin cylinder above an opening in the partition on which the slide rests, so that when the opening in the slide registers with the cylinder, coins will descend and rest on the partition, and when the slide is moved relatively to the partition, coins within the opening between the planes of the slide will be moved with the slide until the opening therein registers with the opening in the partition, when coins will fall through the last mentioned opening. A perspective view of the machine is pictured in the engraving.

CHECK CONTROL STAMPING MACHINE.—PETER LAMBERTI, 161 West 34th Street, New York City. This invention is comprehended in a receptacle adapted to receive mail matter, the receptacle being provided with means for stamping the serial number, together with the hour and date of mailing, and an inscription stating that the required amount of postage has been paid. The object of the invention is to provide a mail box adapted to receive the proper amount of coin for postage when the matter to be mailed is inserted in the box, it being especially adapted for use under the control of the government in public places, thereby providing for considerable saving in the selling of stamps and the handling of mail matter.

Prime Movers and Their Accessories.

STUFFING BOX.—LOUIS CIRAC, care of Hon. D. C. McDonald, Ely, Nevada. This invention is an improvement in packing or stuffing boxes for use on piston rods, valve rods, pump plungers or other similar devices wherein packing is utilized to surround a rod or the like, and the invention has for its object the provision of a simple construction which can

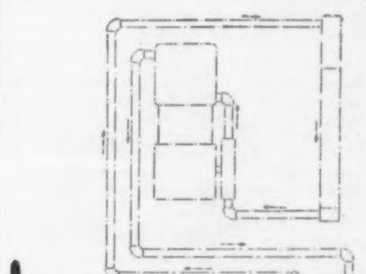


STUFFING BOX

be easily operated to compress the packing and secure a proper packing of the joint and by which lubricant may be supplied directly to the packing through openings in the devices for compressing the packing. It provides efficient lubrication, convenient renewal of the packing and a ready adjustment of the parts whenever necessary or desired. This invention as in use is shown in the engraving in longitudinal section.

Pertaining to Vehicles.

WARMED STEERING WHEEL.—EDWARD T. REICHERT, JR., Room 212, 1547 Broadway, New York, N. Y. This invention refers to a steering wheel with appliances for warming the same, so as to keep the operator's hands in a comfortable condition. It is well known that in the case of launches, aeroplanes, or in open automobiles, without protecting wind shield,



WARMED STEERING WHEEL

the hands of the driver become exceedingly cold, due to the cold wind through which he is rushing. The aim of this inventor is to provide means whereby the steering wheel may be warmed so that the operator may keep his hands warm. A further object is to utilize waste heat in such a manner that it may be circulated through the steering wheel. The view herewith shows diagrammatically the wheel in connection with engine and radiator.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

Researches on the Evolution of the Stellar Systems. Vol. II. By Prof. T. J. J. See. 1910. 735 pp., 4to; 57 full-page insert plates.

In place of Laplace's theory that rings of vapor were once thrown off from the sun to form the planets, and from the planets to form the satellites, Prof. See offers us his capture theory. Instead of regarding the planets as gradually detached from the sun and set revolving in approximately circular orbits, Prof. See endeavors to show that the planets have developed from small nuclei originating in our nebula, at a great distance from the sun, and that their orbits have since been reduced in size and rounded into almost perfect circles by moving in a resisting medium. If that idea is true, the planets were never part of the sun, and Laplace's ideas are wrong. Similarly, Prof. See endeavors to show that satellites now revolving about the planets were originally independent bodies moving in regular elliptical orbits about the sun, but that they were afterward captured and made satellites by dropping in toward the planets about which they now revolve. An existing medium in the form of cosmical dust is assumed to be responsible for the capture of the satellites. The effects of repulsive forces in nature are dwelt upon in this volume even to greater extent than attractive forces. Heavy bodies drifting toward powerful centers of attraction under the action of gravitation alone are assumed to pass into smaller and rounder orbits, with each revolution, by moving in this resisting medium. Light bodies of small mass, in the form of fine cosmical dust, are driven away from the stars by repulsive force, and thus lead to the formation of nebulæ in remote regions of space. Accordingly, the repulsive force at work in the stars scatters the dust to form the nebulæ; the condensation of the nebulæ forms the stars, so that a cyclical process is at work in the universe, the nebulæ producing the stars and the stars in turn producing the nebulæ. Adequate analysis of Prof. See's work can be undertaken only by an astronomer who takes the trouble to check up his calculations. As a daring piece of theorizing on the basis of modern discoveries and mathematical calculation, Prof. See's book must certainly command respect. It cost him fourteen years of more or less constant work to produce it, a fact which is amply demonstrated by its size.

The Conquest of the Air. By Alphonse Berget. G. P. Putnam's Sons. 1911. 249 pp. Numerous illustrations.

This second edition of Prof. Berget's book has been considerably re-written in the effort to bring it up to date. That effort has not been altogether successful. We learn, for example, that the Wright machine still starts on rails, although, as a matter of fact, the Wright machine has for some time been running on wheels, like most biplanes and monoplanes. Apparently, the Wright brothers count for very little as inventors with Prof. Berget. He regards them as mere imitators of Chanute and Lilienthal, and considers Blériot as the real inventor of the man-carrying aeroplane. We learn with some astonishment that the Wright machine owes its success entirely to the remarkable skill of the Wright brothers as pilots, although the author does not point out wherein the operation of a Blériot or any other machine with warping wings, is easier. The part played by such men as Maxim and Langley in the development of flying machines is not sufficiently apparent. Indeed, the chief criticism we have to make against this book is the spirit of French jingoism in which it is written. This applies not only to the discussion of the flying machine, but to the discussion of the dirigible as well. If the reader can overlook these faults, he will find here a good deal of sound aeronautical and aviation principle laid down in a straightforward way which cannot but prove instructive to the man who knows nothing of the subject. The translation, we regret to state, is not altogether idiomatic, and is evidently done by someone not thoroughly familiar with the subject.

The Principles of Scientific Management. By Frederick Winslow Taylor, M.E., Sc.D. New York: Harper & Brothers, 1911. Price, $1.50 net.

These much-discussed Principles are the fruit of Mr. Taylor's thirty years of experience and experimenting. Briefly, his claims are that by the discovery of the laws governing labor, fatigue and rest, and by their scientific application to well-planned tasks, he is able to double and quadruple the output of his men without pushing them to the point of exhaustion. For example, a man who under the old conditions loaded 12½ tons of pig iron per day, now transfers 47½ tons from the pile to the car. In the case of shovelers, the determination of the shovel load is a question of prime importance, and with each different occupation there enters new factors that must be painstakingly weighed and reduced to scientific formulæ. In the face of much shrewd criticism, Mr. Taylor has no less shrewdly defended his position and his theories. There is little doubt that his discoveries inaugurate an era of vastly improved methods, particularly among the heavier occupations. It will be found impossible, however, to reduce the more complex human activities to exact formulæ without destroying to a certain extent the spontaneity, the elasticity, which comes of man's sense of personal mastery and freedom. To use an illustration from athletics, no two jumpers clear the bar in exactly the same way, and to force one method upon all tyros would soon reduce the number of potential champions. So long as the installation of the new methods is intrusted only to capable organizers, and a sufficient margin of safety is maintained to cover the varying personal equation, the spread of these principles of scientific management will be attended only by gratifying results.

History of the Sherman Law. By Albert H. Walker of the New York Bar. New York: The Equity Press, 1910. 8vo.; 320 pp. Price, $2.

The writer characterizes the Sherman Law as a latter-day Magna Charta, a defensive weapon by which the craft of the well-intrenched minority should be shorn of its power to dictate prices on the products necessary to the life of the exposed and helpless majority. Never before has the history of this Law's birth, its fight for life, and its final victory, been presented to the people in such condensed yet adequate form. It makes a readable chapter in our history that should be welcomed by all who have the welfare of the nation at heart. Thousands of speeches, arguments, and decisions have been taken by Mr. Walker and boiled down until the substance of them all is given, and well-given, too, within the space of some three hundred pages.

Our Home City. By William Arthur. Omaha, Nebraska: William Arthur, 1911. 12mo.; 133 pp. Price, 25 cents.

This is the description of an ideal city from the author's point of view His proposal is that a thousand families shall buy the site at agricultural prices, each family building on land leased from the city. The city keeps the title to all land, and owns and operates all public utilities. A plan of such a city forms the cover-design of the booklet, and presents a lay-out that combines symmetry with accessibility and convenience.

Lombroso's Criminal Man. By Gina Lombroso Ferrero. New York and London: G. P. Putnam's Sons, 1911. 8vo.; 332 pp. Illustrated.

Lombroso's criminological theories gave penology a new twist. More and more we are beginning to regard the criminal, not as a savage whom civilization has failed to tame, but as a diseased personality, a subject for the hospital rather than the prison. The book before us is by Lombroso's daughter, Madame Gina Lombroso Ferrero, a lady who has done not a little psychological research on her own account, and is therefore peculiarly well fitted to present a book on her famous father's criminological investigations. Madame Ferrero's book, judging from its style, is intended primarily for the thoughtful reader who has no particular scientific training but who wishes to keep abreast of the scientific times. For such a reader the book seems eminently well qualified. Prof. Lombroso himself read the manuscript before his death and prepared an interesting introduction in which he traces the manner in which he conceived his theory of crime.

Elektrochemische Umformer. By Johannes Zacharias. Vienna and Leipzig: A. Hartleben, 1911. 261 pp.

This book is a very good review of the progress which has been made in the manufacture of galvanic current producers and their application.

Das Schicksal der Planeten. By Svante Arrhenius. Leipzig: Akademische Verlagsgesellschaft, m.b.H. A. Hartleben, 1911.

This is a reprint of Prof. Arrhenius's essay on the atmosphere of planets in Ostwald's "Annalen der Naturphilosophie." Arrhenius's conclusion may be thus summarized: As the magma cooled, a solid crust was formed. Not until then was there an atmosphere or a planetary interior. From the interior of the planet, gases, particularly steam and carbon dioxide, exuded and arose to the highest levels of the atmosphere. On this highly absorbent nascent atmosphere which lies above the clouds, sunlight reacts photo-chemically. Because of the low temperatures of these upper layers, there is a great preponderance of photo-chemical reactions, which are not appreciably affected by cold. As the result of these photo-chemical reactions, and as a result of the ordinary reactions which occur later, oxygen and carbon dioxide are formed. Such gases in the original atmosphere as hydrogen, hydrocarbons, which predominate in the outer layers of celestial bodies, are gradually consumed by oxygen, so that finally, besides oxygen, only a few chemically inert gases are left, such as nitrogen. Steam and carbon dioxide, however, will continue to permeate the atmosphere through crevices in the planetary crust. It was under these circumstances that life first developed. This is the condition of the earth, and possibly of Venus. Gradually the thickness of the crust increases, gradually the waters evaporate, gradually volcanic action ceases, gradually the surface of the planet is transformed into a desert, gradually vegetation dies away, gradually oxygen ceases to be produced, gradually, in a word, the living planet becomes a dead world.

The Principles of Aeroplane Construction. By Rankin Kennedy, C.E. New York: D. Van Nostrand Company, 1911. 137 pp. Price, $1.50.

In this excellent book Mr. Kennedy has explained the principles of the aeroplane, and put in concise form the elementary laws of mechanics and the inclined plane which govern its construction. Formulæ are presented for the determination of the principal dimensions of the aeroplane in its simplest form, with numerically worked out calculations with the two systems in use.

Kometen und Elektronen. By Augusto Righi, Leipzig: Akademische Verlagsgesellschaft m.b.H., 1911.

In this admirable little monograph, Prof. Righi has applied the discoveries of the English school of physicists, who have given us the electronic theory, to the phenomena of comets. Radiation pressure alone is not sufficient to explain many of the vagaries of a comet's tail. But the application of the electron theory undoubtedly helps considerably to clear up many a mystery. The last chapter in the monograph is devoted to the consideration of the passing of the earth through the tail of Halley's comet, on May 19th, 1910.

Flying Machines To-day. By William Duane Ennis. New York: D. Van Nostrand Company, 1911. 205 pp.; numerous illustrations. Price, $1.50.

Prof. Ennis has written one of the most sensible books on flying machines that we have seen. The title of his work, to be sure, is rather misleading, for he discusses lighter-than-air craft as well as aeroplanes. Written primarily for the layman, the book sets forth the principles of the aeroplane and the dirigible with such clearness that a man of average èducation ought to be able to understand the explanation. It is difficult, of course, for a work on aviation to be strictly up-to-date, for the art progresses so rapidly that improvements are made almost from week to week. Still, it must be said that the author made a commendable effort to keep his reader informed of the more recent progress in flying machine construction.

The Universal Railway Manual. 1911. Containing Valuations of the Principal British, American, and Foreign Railway Stocks. Edited by Capt. L. E. Hopkins, R.E. London: Society of Railway Stock Holders. New York: The Macmillan Company. 12mo.; 596 pp. Price, $2.50 net.

This valuable book is based on the company valuations, reports of government statistics, etc. There is also a considerable free criticism as to the financial position of companies, which is entirely disinterested. The work has been done in the most admirable manner, and the book is one of the best compendiums of financial information that we have ever seen. The maps and diagrams are particularly clear, and the book is one which should be in the library of every well-informed person. Railway systems of the world form a most fascinating subject.

Charts of the Atmosphere for Aeronauts and Aviators. By A. Lawrence Rotch, S.B., A.M., and Andrew H. Palmer, A.M. New York: John Wiley & Sons, 1911.

This book of Prof. Rotch's is the first attempt made in this country to collect for the use of the aviator and the aeronaut in a readily understood form, the vast amount of data which have been accumulated at the Blue Hill Meteorological Observatory, one of the pioneer institutions of its kind. We believe that somewhat similar work has been done in Germany and Italy. The book consists of a series of charts which gives the relative heights attained by various aerial vehicles; atmospheric density and temperature; average temperature, barometric pressure, wind velocity, and pressure up to 30,000 feet; maximum wind velocities and pressure up to 30,000 feet at Blue Hill; wind pressures for constant velocities up to 30,000 feet; wind pressures for constant velocities up to 10,000 feet; monthly temperatures up to 12,000 feet at Blue Hill; monthly wind velocities up to 12,000 feet at Blue Hill; hourly wind velocities up to 10,000 feet at Blue Hill; frequency of constant wind velocities, 1,000 to 10,000 feet at Blue Hill; frequency of winds at Blue Hill, 650 feet; velocity of winds at Blue Hill, 650 feet; frequency of winds at Blue Hill, 1,650 feet; velocity of winds at Blue Hill, 1,650 feet; frequency of winds at Blue Hill, 3,300 feet; velocity of winds at Blue Hill, 3,300 feet; frequency of winds at Blue Hill, 6,600 feet; velocity of winds at Blue Hill, 6,600 feet; frequency of winds at Blue Hill, 10,000 feet; velocity of winds at Blue Hill, 10,000 feet; wind velocity and direction up to 13,000 feet at St. Louis; winds at various heights as related to barometric pressure at the ground; frequency of winds in the N. E. trade region of the Atlantic Ocean; velocity of winds in the N. E. trade region of the Atlantic Ocean; aerial routes in summer across the North Atlantic Ocean. Each chart is accompanied by simply-worded explanations, which will enable the aeronaut and the aviator to appreciate the significance of the facts conveyed by the charts.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12542) **H. S. D. asks:** Have you any publications regarding the making of ice by the vacuum process? I have placed a small amount of water under a bell jar with some sulphuric acid and have exhausted the air. The water cools but fails to freeze. According to theory, should water freeze under the above conditions? Can you suggest any method for freezing water under vacuum? A. The experiment of freezing water under a bell jar of a common air pump is a very difficult one. The vacuum is usually too low. The metal of the pump conducts heat into the water nearly as rapidly as the evaporation takes it out of the water. With a quick-acting high-grade pump, and by protecting the glass in which the water is contained from the metal of the pump, the freezing of the water will occur, but not rapidly. A very small and broad bell jar must be used. The sulphuric acid must be in a broad dish. The water is usually in a flat watch glass over the acid, supported by a wire frame which rests upon the glass dish in which the acid is put. The older books of physics usually have pictures of the arrangements. You will find it in Deschanel, Vol. II, as well as the picture of Carre's apparatus for freezing water in bottles by the same method, which was once largely used, but has now gone out of use.

(12543) **F. K. writes:** Occasionally I see mention made in your valuable journal by writers claiming to have seen ball lightning drop from the clouds, the accuracy of which is questioned by some and as being an illusion. I distinctly remember one afternoon about 4 o'clock having seen such a ball drop from the clouds; was from a thunder cloud in the northwest sky. I was facing the cloud at the time. To me it appeared to be about six inches in diameter, and as it descended sparkled with short electric bristles until it reached *terra firma*. I was returning from a field at the time, and take distance between me and where it reached the earth to have been about half a mile. This was at Centerhall, Pa. I at once concluded when reaching the village to inquire whether the phenomenon had been observed there, and to my astonishment learned that "lightning had struck the house of Alex. Shannon," followed the chimney down into the kitchen, where a little daughter was standing close to the range, and was instantly killed. There was no other flash of lightning at the time, hence there can be no doubt that the ball lightning killed the little girl. The ball was about two and a half seconds in its descent. A. There was a time when the existence of a slowly moving globe or shining ball of electricity, which afterwards might explode with great force, producing all the effects of a lightning stroke, was denied and even ridiculed by scientific men. We think all now admit the reality of these occurrences.

(12544) **W. F. M. asks:** 1. Is iron or steel while very hot, or in a molten state, absolutely unaffected by magnetic lines of force? A. Iron or steel above red heat cannot be magnetized. 2. Will a thin sheet of iron held in front of the poles of a powerful magnet cut off all the "pull" of the magnet? A. A thin sheet of iron will not cut off all lines of magnetic force. A plate of sufficient thickness to furnish a path for the lines of force below saturation must be provided. For wrought iron about 100,000 lines can be carried per square inch of cross section. Even then there will be leakage into the air.

(12545) **W. G. M. asks:** I have a pipe that leads from my well 14 feet higher than my sink. I fill the pipe with water, and the water will flow from three to five days, then stop. I have put a pump on and sucked the water down and have the same trouble. I have to lift the water about 4 feet from surface to where the pipe turns to go down. I would like to know the cause of its stopping, or how I can remedy it. A. The intermittent action you describe is inevitable with the simple siphon. Air carried into the pipe with the water escapes, as the pressure is reduced during the passage of the water up the pipe, and collects in the bend. When sufficient air has accumulated, the water column breaks and the flow stops. When this occurs the air must be removed by pumping it out or by refilling the pipe with water. These interruptions may be delayed by providing an air chamber at the high point of the siphon, so that the air may collect for a longer time before it interferes with the flow in the pipe. With a cock below the air chamber, and a plug or cock at the top, the whole air chamber may be filled with water whenever the collected air breaks the siphon's flow.

The Harvest Moon

(Continued from page 299.)

angle of 66½ degrees to the plane of the ecliptic; and moreover the plane of the moon's orbit, which is inclined at an angle of a little over 5 degrees, has a retrograde motion, making a complete rotation in 18.6 years. The diminution of the retardation of the rising of the harvest moon is also variable, and dependent upon the latitude of the observer and the position of the moon's orbit. When the moon is midway between the nodes its direction of motion is parallel to the plane of the ecliptic. When it is at or near a node (which may be either ascending or descending) the direction forms an angle of about 5 degrees with the ecliptic.

The plot shows the positions of the earth (E) and of the moon at the dates of full moon—September 8th and October 7th; and also of new moon on September 22nd. The moon's orbit rotates in the direction of the arrow without the orbit; the arrow within the orbit is the direction of the moon's motion. Figs. 1-4 represent the moon's orbit projected on a plane which is perpendicular to that of the ecliptic, and parallel to the earth's axis. The scale is enlarged and shows the relative diameter of the earth and of the moon's orbit. Fig. 1 shows the plane of the orbit seen edgewise. In Fig. 2 the ellipse represent the orbit after one-quarter of a rotation. Fig. 3 shows the plane of the orbit, again seen edgewise after one-half of a rotation. The ellipse Fig. 4 shows the orbit after three-quarters of a rotation. One-quarter of a rotation more brings the orbit back again to the position Fig. 1. Fig. 5 is the position of the orbit in September of this year, and is situated between those shown at Figs. 2 and 3. It is a view looking in the direction of the arrow A. In each of the illustrations the direction of the moon's motion is indicated by an arrow showing that part of the orbit which is near to, or farther from the reader.

Fig. 6 is drawn to a very much larger scale, in order that the parallels of latitude on the earth's surface may be plainly visible; and to show some of the conditions which may affect the rising of the harvest moon. In order to bring the illustrations within the limits of the page, only a small part of the orbit and two positions of the moon are included. The distance from a to b, and from c to d, show the average distance traversed by the moon in 24 hours, when it reaches the maximum distance above and below the plane of the ecliptic. If the positions a and b (below the ecliptic) were equidistant from e and from the earth's center, the moon would rise on consecutive evenings at exactly the same time to an observer situated very near P on the visible hemisphere. Also if the moon occupied the positions c and d (above the ecliptic) under similar conditions it would rise at the same time on consecutive evenings to an observer situated very near P on the invisible hemisphere. In the first case the plane of the horizon passes through a and b; in the second it passes through c and d. In order to realize that the position of the observer in each case is near P, it must be remembered that the moon's distance from the earth is more than sixty times the earth's radius. The latitude of P is 66½ degrees (the polar circle). It is a well known fact that the harvest moon rises at or about the same time on consecutive evenings, in the north of Norway and Sweden. From an inspection of Fig. 6 it is evident that there would be a retardation at lower latitudes—as for example that of New York at Q.

When the plane of the moon's orbit is in the position corresponding to Fig. 1 forming a small angle with the equator; and the moon on consecutive evenings is at f and g, the retardation of the moon's rising is evidently greater than when the direction of the moon's motion is parallel to the ecliptic. When the orbit is rotated into the position corresponding to Fig. 3, and the moon on consecutive evenings is at h and k, the plane forms a larger angle with the equator, and the retardation is diminished. The illustrations might be extended indefinitely; but in general those here given show that in high latitudes the retardation is less than in lower latitudes; and that under favorable conditions at a high latitude, the moon may rise even earlier the second evening.

Fig. 7 shows the plane of the horizon when the moon is above and below the ecliptic; and also the positions of the observer p and p' at the time of moonrise.

Submarine Cables and Longitude Determination

(Concluded from page 298.)

strong enough to operate the electro-magnets. This cannot be done when the stations are connected by a long submarine cable, because the impulsive currents are too feeble to affect any but extremely sensitive receiving apparatus.

This difficulty has been overcome by Col. Bourgeois, director of the geographical service of the French army, who was recently commissioned to devise a method of determining the difference of longitude between Brest, in France, and Dakar, in Senegal, which are connected by a cable about 2,800 miles long.

The receiving instrument employed in submarine telegraphy is the siphon recorder, invented by Sir William Thomson (Lord Kelvin). This instrument consists essentially of two very powerful electro-magnets between which is suspended, by two parallel fibers of cocoon silk, a small and light coil containing a great number of turns of very fine wire. The strength of the magnetic field is increased by a core of soft iron, fixed immovably inside the coil, which can turn freely without touching either the core or the electro-magnets. The coil, when no current is passing through it, is held parallel to the line of the magnetic poles by its bipolar suspension, but a positive or negative current causes it to deviate to the right or left from its position of equilibrium. A system of levers magnifies these movements and transmits them to a little glass siphon formed of a bent capillary tube. The short leg of the siphon dips into a vessel filled with a very fluid ink, and the long leg, which is drawn out to a fine point, moves transversely in front of a strip of paper, which is drawn along uniformly by clockwork. The ink is electrified by a small electrostatic machine and is therefore projected upon the paper in a continuous spray. When the siphon is at rest this spray marks a straight line parallel with the length of the moving strip of paper, but when the siphon is turned to right and left by the moving coil the result is a wavy line, the elevations and depressions of which correspond to the dots and dashes of the Morse code.

In Col. Bourgeois's method of determining longitudes by cable a double chronograph and a single siphon recorder are employed at each station. The chronograph is used to compare an auxiliary clock with the standard astronomical clock, while the siphon recorder is connected through a local battery with this auxiliary local clock and through the cable with the standard auxiliary clock of the distant station. Hence the jet of ink traces on the moving strip of paper a straight line interrupted by two series of indentations, each representing intervals of a definite fraction of one second, the odd-numbered indentations (for example) being made by the distant standard clock, and the even-numbered indentations by the local auxiliary clock, the error of which, with respect to the local standard clock, is known from the chronograph record. In the preliminary experiments it was discovered that the siphon recorder and the chronograph pen, both of which are connected with the auxiliary clock, are not equally quick in action, but as the difference is less than 1/100 second, it is of no practical importance. The indentations produced by the siphon recorder are less sharply defined than the marks made by the chronograph pen, but they are quite sharp enough for the determination of longitude.

A Radium Lode.—According to press dispatches, Dr. Douglas Mawson announces that he has discovered a valuable deposit of radium ore at Mount Painter, in the far northern district of the State of South Australia. According to his report, the deposit is of high grade.

Aeronautics

The International Balloon Race.—Nine balloons are entered in the international cup race which starts from Kansas City on October 2nd. America will be represented by Lieut. Frank P. Lahm, Capt. John Berry, and Wm. F. Assman; France by Emile Dubonnet, Alfred Le Blanc, and Welby Jourdan; and Germany by Lieut. Vogt, Ingenieur Gerickee, and Freiherr von Pohl.

Exhibition Flights at Brighton Beach.—As we go to press the American Aviation Co. is about to conduct an aviation meet at Brighton Beach Race Track on the 8th, 9th and 10th inst. Flights will be made by Grahame-White, in his speedy Nieuport monoplane, by Harry N. Atwood, Wm. Beatty in their Wright biplanes, and Eugene Ely in his Curtiss biplane. This is the first attempt to use the Brighton Beach Race Track for flying that has been made in some time, and it is hoped that it will meet with success and with the patronage of the New York public, as if this is the case, there will probably be more exhibition flights made there in the near future.

The Aviation Meet on Long Island.—The first big aviation meet to be held in the East opened on the 23rd inst. at the Nassau Boulevard aerodrome of the Aero Club of New York. Mlle. Helene Dutrieu, who pilots a Farman biplane, has come from France to compete against our American aviatresses, Miss Quimby and Miss Moisant. A demonstration of military aviation was given the first day of the meet. An official aeroplane postal service was also maintained from the aerodrome to the outskirts of Brooklyn, so that letters or souvenir postals mailed on the grounds could be started through the air almost immediately. Various novel races and contests are also on the programme.

A Wonderful Altitude Record.—In our last issue, we mentioned Beachy's new altitude record of 11,640 feet made at Chicago recently. This has since been exceeded by 2,000 feet by Garros in a Bleriot monoplane. On September 4th this daring French aviator ascended to a height of over 2½ miles (4,500 meters), or 12,954 feet. This startling performance would indicate that there is no limit to the height to which an aeroplane can soar. Garros reached an elevation almost as high as Pike's Peak, in Colorado. It has always been supposed that the monoplane was more difficult to drive to such great elevations than the biplane, but such has been demonstrated to be untrue and the monoplane now holds the palm for height as well as for speed.

A New Michelin Prize for War Aeroplanes.—Mons. Michelin has just offered a new prize of $20,000 for bomb dropping by aeroplanes. Mons. Michelin, it will be remembered, offered a like amount for a flight of some 225 miles from Paris to the Puy de Dôme Mountain over three years ago, this prize being won last March—exactly three years to a day after it was offered—by Reneaux on his Maurice Farman biplane. Mons. Michelin believes in the future of the aeroplane and thinks that large prizes should continually be offered with the idea of perfecting it still further. The rules of the new prize have not yet been drawn up, but the idea is to give the prize to the aviator who is most successful in dropping the greatest number of projectiles nearest to a given spot marked on the ground.

New York's Aviation Meet.—Despite the fact that the big meets recently held at Chicago and Boston have both been financial failures, the Aero Club of New York, of which Honorable Timothy L. Woodruff is President, expects to hold an International Meet at its Nassau Boulevard Aerodrome from the 23rd to the 30th of this month. Arrangements have been made for several of the well known foreign aviators to compete at this meet. Mlle. Dutrieu, the aviatress who recently won the "Femina cup" for a long distance flight of 2 hours and 32 minutes cross country, in which she covered 104 miles, expects to compete in her special Henry Farman biplane. The army aviators will also probably conduct maneuvers showing the use of the aeroplane in warfare, and there may also be made some experiments in the transporting of mail by aeroplane.

Engineering

Rare Metals in Canada.—It is reported that important deposits of platinum, iridium, palladium, rhodium and osmium have been dscovered a few miles from Nelson, B. C. A well-defined dike bearing these metals is said to have been traced for several miles in the general direction of Forty-Nine Mile Creek and across the Kootenay River, and many claims have been staked.

Edward Whymper.—The death of Edward Whymper removes the nestor of mountain climbers, the man who led the way up the Matterhorn in 1865 and first showed the possibilities of the Canadian Rockies. Whymper's wonderful achievement in ascending Chimborazo (20,500 feet), has been surpassed by others, but he will always remain a pioneer of distinction. Some of his books passed through many editions, and are now regarded as classics. Whymper was well advanced in his seventy-second year. He died at Chamounix, among the tall mountains and glaciers he loved so well.

The Lotschberg Tunnel.—Although the great Lötschberg tunnel is now open, it will be two years before trains are crossing the Bernese Oberland. The new tunnel is nine miles long; a little shorter than the St. Gothard, and three miles shorter than the Simplon. It was built largely through the enterprise of the business men of Bern, in order to divert to that city a share of the transalpine traffic, most of which is now monopolized by other Swiss cities which are more favorably situated with respect to the Simplon and the St. Gothard. Its construction occupied four years and five months, and was marked by two great catastrophes, an avalanche and a cave-in, each of which cost a number of lives.

Irrigation of the Yangtze Valley.—A project is now under consideration to construct an elaborate irrigation system in the Yangtze valley—possibly the most costly undertaking of this kind in the history of engineering. Its object is twofold, viz., to improve the agricultural conditions of the country, and—more especially—to prevent a recurrence of the terrible floods which have devastated the valley during the present year. Independently of this project, Charles Jameson, the American engineer sent to China by the Red Cross Society, accompanied by an engineer deputed by the Chinese government, is about to make a survey of the famine districts of Kiangsu and Anhui, which are subject to these recurring floods.

Progress of the African Railways.—By next July there will be continuous railway communication between Cape Town and the town of Kambove, in the Congo, 270 miles north of the Rhodesian boundary; a total distance of over 2,400 miles. The railway is already in operation as far as Elizabethville, 165 miles north of the Congo border. From Kambove an extension has been surveyed to Bukama, 200 miles farther north, on a navigable tributary of the Congo. In a few months a railway will be begun from Kambove westward 100 miles to Ruwe. This is destined ultimately to connect up with the line that is being pushed eastward from Benguela, on the Atlantic coast, and which now extends 230 miles into the interior.

Relics of the French Panama Canal.—On September 5th bids were opened in Washington for the French "scrap" that so picturesquely and tragically strews the route of the Panama Canal. It includes abandoned locomotives, dump cars, tanks, barges, dredges, boilers, girders, sheet iron, parts of old machinery, and miscellaneous junk—the relics of De Lesseps's greatest and most disastrous undertaking. Every one who has visited the Isthmus has brought away vivid recollections of these gaunt monuments, as well as of the incredible tales with which they have come to be embroidered. It used to be related that the French settlement of Christophe, adjoining Colon, was built on a foundation of locomotives dumped by the shipload into the virgin swamp. The material is to be removed by the contractor at his own expense, the Panama Railroad charging $2.25 a ton for its transportation to the seaports. Three years will be allowed for its removal.